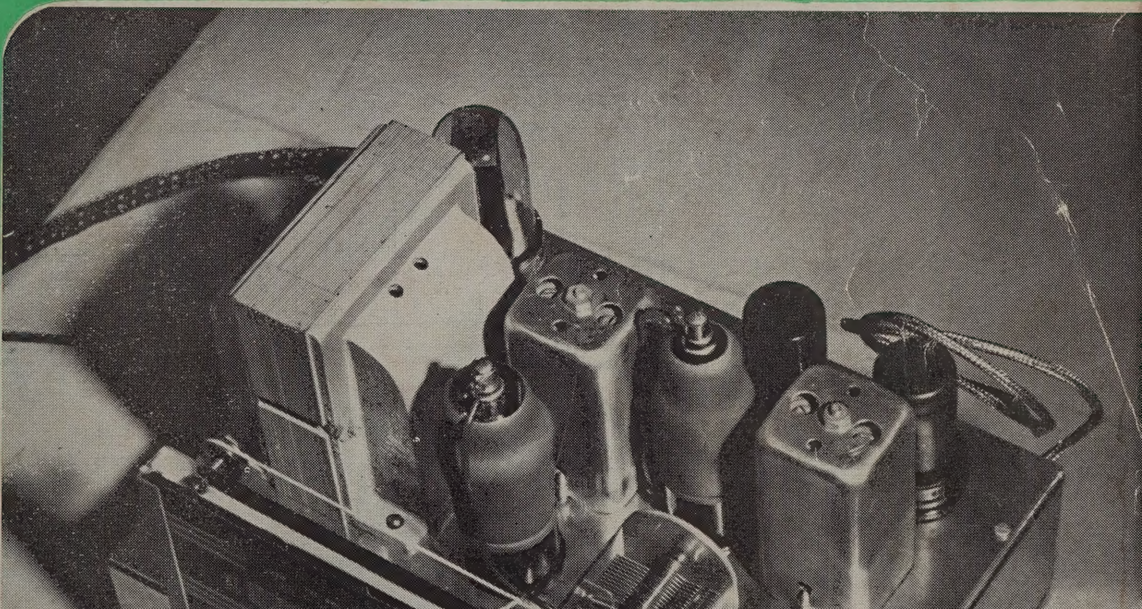
RADIO *and* ELECTRONICS

ELECTRICITY —— COMMUNICATIONS —— SERVICE —— SOUND



APRIL, 1st, 1953 VOL. 8, NO. 2

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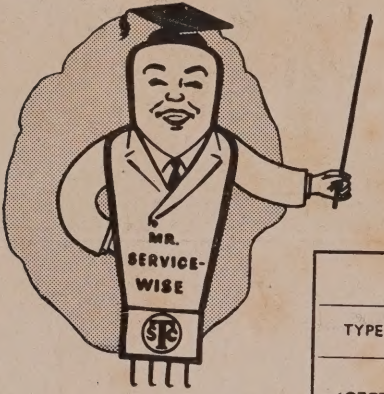
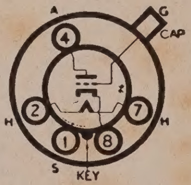
IF YOU'RE SHORT OF 6F5's —SOLUTION IS TO ★BRIMARIZE

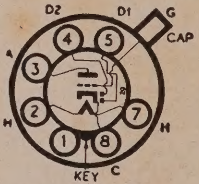


Types 6F5 and 12F5 are high-mu triodes for which the triode portions of the double-diode-triode types 6Q7GT and 12Q7GT form efficient substitutes. These valves are International Octals and call for very little alteration to the wiring. Any connections to pins 3 and 5 of the 6F5 socket will be for anchoring purposes only and these must be removed before Brimarizing.

TYPE	CHANGE SOCKET FROM	 TO	CHANGE CONNECTIONS FROM OLD SOCKET	 TO NEW SOCKET	PERFORMANCE CHANGE	REMARKS
6Q7GT	INT/OCTAL NO CHANGE		PIN 3 .. 4 .. 5	REMOVE PIN 3 REMOVE	SLIGHTLY LESS GAIN	In certain sets pins 3 and 5 of the 6F5 may be used as soldering tags. Any connections to these tags must be removed before Brimarizing.
12Q7GT	INT/OCTAL NO CHANGE		PIN 3 .. 4 .. 5	REMOVE PIN 3 REMOVE	SLIGHTLY LESS GAIN	



6F5
12F5



6Q7GT
12Q7GT

RATED CHARACTERISTICS

	6F5	6Q7G/GT
Heater Voltage	6.3	6.3 volts
Heater Current	0.3	0.3 amp.
Anode Voltage	250	250 volts
Anode Current	0.9	1.1 mA
Amp. Factor	100	70
Bias Resistor	3,000	3,000 ohms

NOTE : The characteristics of types 12F5 and 12Q7GT are identical to those of types 6F5 and 6Q7G/GT respectively, except for the heater ratings, which are 12.6v., 0.15A.

★ ***BRIMARIZING — a service which first-class dealers can offer those customers whose radio sets have been designed round certain valves which are now in short supply***

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Radio and Electronics

VOL. 8, No. 2 1st April, 1953

OUR COVER
this month shows a view of the dual-purpose tuner described in an article on Page 2 of this issue.

●

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CORRESPONDENCE
All correspondence and contributions should be addressed to:

The Editor,
"Radio and Electronics,"
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OFFICES AND LABORATORY:
Radio and Electronics (N.Z.), Ltd.,
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And Now 45 R.P.M.

It is now some time since the Decca long-playing records made their appearance on the New Zealand market and created such a stir among gramophone enthusiasts. In October of last year, the first L/P records under the H.M.V., Columbia, and Parlophone labels made their appearance in the United Kingdom, and recent advice is that the first releases will be available here very soon. This is indeed good news, because those of us who have become used to the boon of not having to jump out of our chairs every four minutes, or put up with the mechanical performance of the automatic changer just when the continuity of the music demands that the performance be unbroken, have come to grow slightly impatient with even our favourite sets of 78 discs! Before long, the issuing of L/Ps on these new labels will considerably extend the choice, and we will not be faced with buying a set of 78 discs because we like a particular performance of a work which does not appear in the L/P catalogue. One noteworthy fact about the first issues from E.M.I. is that many of the titles are L/P pressings of performances which have already appeared on 78 R.P.M. records. It is possible that some enthusiasts may be put off by this, on the mistaken assumption that the L/P versions are "dubbings" from the original 78 sets. This may have been true of certain L/Ps issued in America several years ago, but we do not believe it to be so of this recent issue from England. The point is that the 78s which have been duplicated on L/P are all of recent enough vintage for the master recording to have been made on tape. When this is the case, there is obviously no question of dubbing, or of the surface noise from the 78 disc being reproduced on the L/P one, since the latter's master disc can be made from the original tape without the intervention of a 78 disc at all.

Another point that will interest a good many is that quite a large number of 45 R.P.M. records have been issued as well as the 33⅓ R.P.M. ones. This is a completely new departure as far as we are concerned, because none of the American 45s have been available here. No doubt many readers of *Radio and Electronics* will want to know whether they will be able to play these discs without purchasing more equipment still, and if so, what are the supposed advantages of 45 as against 33⅓ R.P.M.

The 45s should not cause very much difficulty to those wishing to play them, as long as they have a turntable that will revolve at the correct speed. A large number of three-speed record-changers and single players have been sold in this country, so that all owners of these units will be able to heave a sigh of relief. However, there is one difficulty to which we do not at present know the full answer. It is that the 45 R.P.M. records have a very much larger centre-hole than the others—approximately 1½ in. in diameter. The reason for this is that in America, where they were originated by the R.C.A., they were released in conjunction with a specially designed automatic changer. The latter is one of the neatest things of its kind, since the changing mechanism is entirely contained in the large centre spindle, and has no weird structures for supporting the stack of records, as most other changers have. The trouble is, as far as we are concerned, that even if we have turntables that will go at the right speed, they have the normal small spindle, which will not suit the 45 records. However, a very simple attachment, in the shape of a washer, of the right thickness, and with a centre hole which fits the normal spindle, will enable the records to be played on ordinary equipment, although it is doubtful whether such a simple scheme will enable an automatic changer to change them.

The other important point concerns the pick-up. The 45 R.P.M. records must be played with the same head or stylus as is used for the 33⅓ records, since the groove has the same dimensions as these. In addition, their frequency response is very similar to that of the 33⅓ records, and the frequency compensation suitable for the latter will play the 45s satisfactorily.

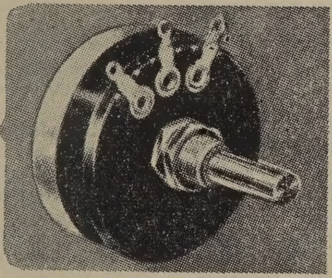
What are their advantages? Technically, they should be better than the inside portions of the 33⅓ discs, as the higher rotational speed, together with the larger minimum diameter, gives the 45s a higher groove speed at the inside, and a considerably higher one at the outside, than at 7 in. diameter on a 33⅓ disc. The other advantages are concerned mainly with convenience. The seven-inch 45 R.P.M. discs have been made to have approximately the same playing time as a 12 in. 78 disc, so that the 45 is rather better suited to short musical pieces than is the 33⅓. With the 45s, it will not be necessary to buy a record containing a selection of short pieces one does not really want, in order to get one particular piece. It is obvious that the 45s will fill a requirement, and that they will not be "just another kind of record," in competition with the others.

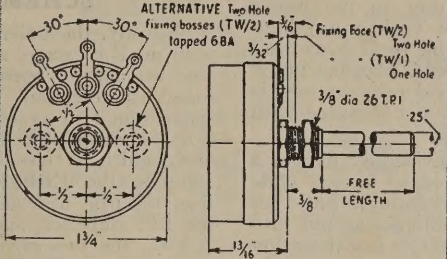
TRAINING FOR T.V. ARE YOU INTERESTED?

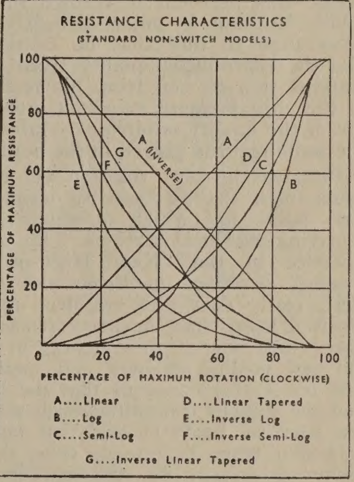
We would like to draw readers' attention to an announcement appearing on page 47 of this issue. We have had occasion to comment more than once on the problems connected with giving radio men an adequate training in TV matters before it is too late. The announcement referred to represents a practical approach to one aspect of the matter, and we would urge all those interested in TV to read it.

RELIANCE POTENTIOMETERS

—BRITISH TO THE CORE







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Quality is the keynote in Reliance design and manufacture. The resistance wire is of nickel-chrome or copper-nickel alloy. Terminal ends are specially metallized to obtain negligible resistance at end of travel of contact arm. Resistance element is impregnated with neutral elastic varnish. Two or three units ganged to common spindle are available in any combination within the standard resistance range.

MECHANICAL DATA:

Available in either one or two-hole fixing. One-hole fixing bush $\frac{3}{8}$ in. diam., $\frac{3}{8}$ in. long from mounting face. Less in two-hole fittings. Standard Spindles $\frac{1}{4}$ in. diam., 1 in. long (free length). Spindles slotted or with Flats available for different knob types. Resistance to overturning knob is 10 lb. — in.

ELECTRICAL DATA:

Wattage ratings for whole element uniformly loaded (linear winding, Curve A); considerably reduced when resistance element graded or used as rheostat. Resistance elements correct to + or — 5% stated value. Terminal resistance at end of wiper arm travel negligible. Resistance windings graded to R.C.M.F. standards (illustrated graph). Specify grading letters when ordering. Tested to withstand 1000v. D.C. between spindle and cover, spindle and wiper arm.

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A Tuner for the Amplifier Enthusiast

In these pages we have, over a period, offered readers several alternatives for achieving reasonably high-quality radio reception, such as will match the performance of a good amplifier and pick-up on gramophone records. This article describes another way of tackling the problem, and at the same time allowing for long-distance broadcast reception without additional equipment.

INTRODUCTION

One of the perennial problems of radio receiver design is the high-quality tuner. These days, when it is a relatively easy matter, given the right equipment, to have a superb reproduction from gramophone records, this problem is thrown more than ever into relief. Nothing is more disheartening to the music lover than to find that he cannot realize anything like the reproduced quality from the local broadcast stations that he can from his records, because much of the enjoyment of excellent musical programmes is lost if the quality is obviously inferior, compared with the same records played in the home.

Perhaps the best solution yet devised is to use a radio tuner that is specially designed to have a wide pass band, but which is sensitive enough only for receiving the local stations. This scheme, as put into practice in the "New High-quality Local-station Tuner," described in *Radio and Electronics* in July, 1951, really does give excellent results, and we have received many complimentary remarks from those who have heard one of these tuners in action, followed by the best quality amplifier and speaker. We have been told on several occasions that the listener had no idea that the stations transmitted such wonderful quality, and one user we know of said that until he acquired this particular tuner, he literally never listened to radio programmes, so poor was the reproduction from ordinary receivers compared with his record-player. From our own observations, we would endorse these remarks, throwing editorial modesty to the winds, for this particular tuner certainly does give the best radio reception on strong local signals that we have ever heard.

Unfortunately, however, there is a snag, which will undoubtedly put many people off, and it is that the tuner referred to is strictly "local stations only." It frequently happens that one wants to receive more distant stations, even if, like the writer, 95 per cent. of one's listening time is restricted to the locals. In order to do this, with the tuner we are discussing, the ony way out is to have an entirely separate, conventional tuner, which will give distant broadcast, and perhaps short-wave reception, too. There is nothing against this course, except the expense of having two tuners, one of which is hardly ever used, so that there is still room for a tuner which will give ordinary sensitivity and selectivity, for distant reception, but which can be broadened out, and the sensitivity reduced, for high-quality local reception.

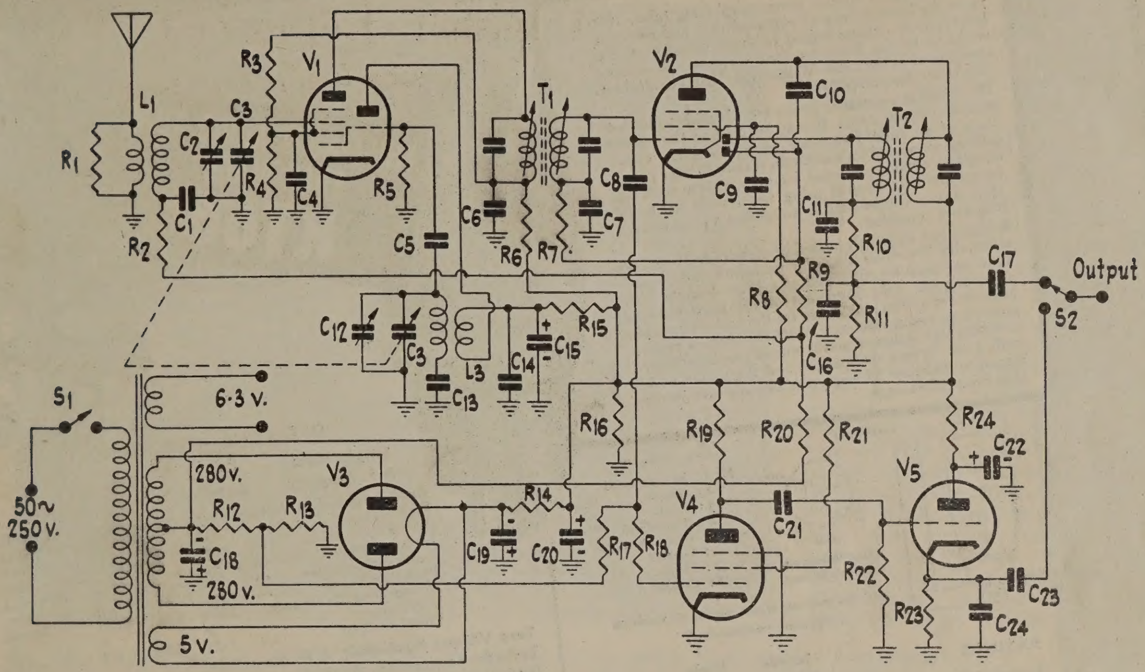
One partial answer to this is the tuner with band-expanding I.F. transformers. These transformers do enable a considerably wider pass band to be received, and result in better reception of local stations, but there is a limit to the broadening that can be achieved, and a still wider pass band is really required. The tuner described in this article represents an approach to the problem which is different again, and which will be found to give results intermediate between those of the special local-station tuner, and the conventional one with band-expanding I.F. transformers. It achieves its results by using two separate valves, which are in use only on the "broad" position of the selectivity switch. It is thus slightly more expensive in parts than a conventional tuner, but considerably less costly than two separate tuners.

SCHEME OF THE TUNER

Basically, the tuner is a conventional superhet circuit, with no R.F. stage, and one I.F. stage, and as such has any amount of sensitivity and selectivity for ordinary broadcast reception. V_1 is an ECH35 converter, and is conventional in every way. V_2 is an EBF32, which is a double-diode-pentode, somewhat reminiscent of the old 6B8, which is obsolescent, and difficult to obtain. In addition, the EBF32 has rather better characteristics than the 6B8 had, and with the pentode section used as the I.F. amplifier, and the diodes used for detection and A.V.C., the two-valve conventional tuner is as sensitive as any commercial 5-valve superhet.

Where, then, does the broad-banding come in? Through having a separate, untuned I.F. amplifier stage, followed by its own detector valve. Then, in order to switch from "narrow" to "broad" the input of the audio amplifier is switched from one detector to the other. The extra bandwidth, or lack of selectivity, whichever way you like to look at it, comes from the fact that the untuned I.F. amplifier is fed from the output of the first I.F. transformer, so that the only I.F. selectivity operative in the "broad" position is that due to the first transformer. The gain in bandwidth obtained in this way is quite considerable, since the response at frequencies off resonance is doubled.

At first it was thought that an infinite-impedance detector following the first I.F. transformer would be satisfactory, thus doing away with the untuned I.F. stage. Unfortunately, this did not work out, because the signal level at the output of the mixer is so small that the detector was able to produce considerable distortion. This is not an indictment of the infinite-impedance detector, because all so-called linear detectors, including the diode, do not rectify linearly unless the signal level is high enough. Since bandwidth is useless unless distortion can be eliminated, it was decided that the best cure was to insert an untuned amplifier stage. This is simply a high-gain valve, resistance-coupled to the detector. It gives a gain of some 25 times, so that the output from the infinite-impedance detector is approximately the same as that of the diode in the conventional part of the tuner, as long as only the local stations are considered. It will be seen from the circuit, that the ordinary detector and the A.V.C. rectifier function all the time, whether the selector switch is in the "narrow" or the "broad" position. In this way, the tuned I.F. amplifier and the A.V.C. rectifier act as an amplified A.V.C. system so far as the broad channel is concerned. This is of great practical benefit, because it ensures that A.V.C. action on the local stations is as good as is obtained with a conventioned tuner. Most low-gain local-station tuners suffer from the fact that the gain



COMPONENT LIST

R_1, R_{24}, 20k.
R_2, 1 meg. or 100k. (see text).
R_3, 25k.
R_4, R_{21}, 33k.
R_5, R_{10}, R_{15}, 50k.
R_6, 1500 ohms 5 watts.
R_7, R_9, R_{17}, R_{22}, 1 meg.
R_8, R_{23}, 100k.
R_{11}, R_{20}, 500k.
R_{12}, R_{13}, 27 ohms.
R_{16}, 15k. voltage divider.
R_{18}, 1k.
R_{19}, 5k.
C_1, C_7, 0.1 μf.
C_2, C_{12}, 3–30 $\mu\mu$f. trimmers.
C_3, 2-gang condenser.

C_4, C_6, C_9, C_{17}, C_{23}, 0.05 μf.
C_5, C_{10}, C_{11}, C_{16}, C_{24}, 50 $\mu\mu$f.
C_{13}, padder.
C_{14}, 0.01 μf.
C_{15}, C_{22}, 8 μf. 350v. electro.
C_{18}, 25 μf. 25v. electro.
C_{19}, C_{20}, 16 μf. 450v. electro.
C_8, C_{21}, 100 $\mu\mu$f.
L_1, aerial coil.
L_2, oscillator coil.
T_1, T_2, 455 kc/sec. I.F.T.
V_1, ECH35.
V_2, EBF32.
V_3, 5Y3.
V_4, 6SG7.
V_5, 6J5.

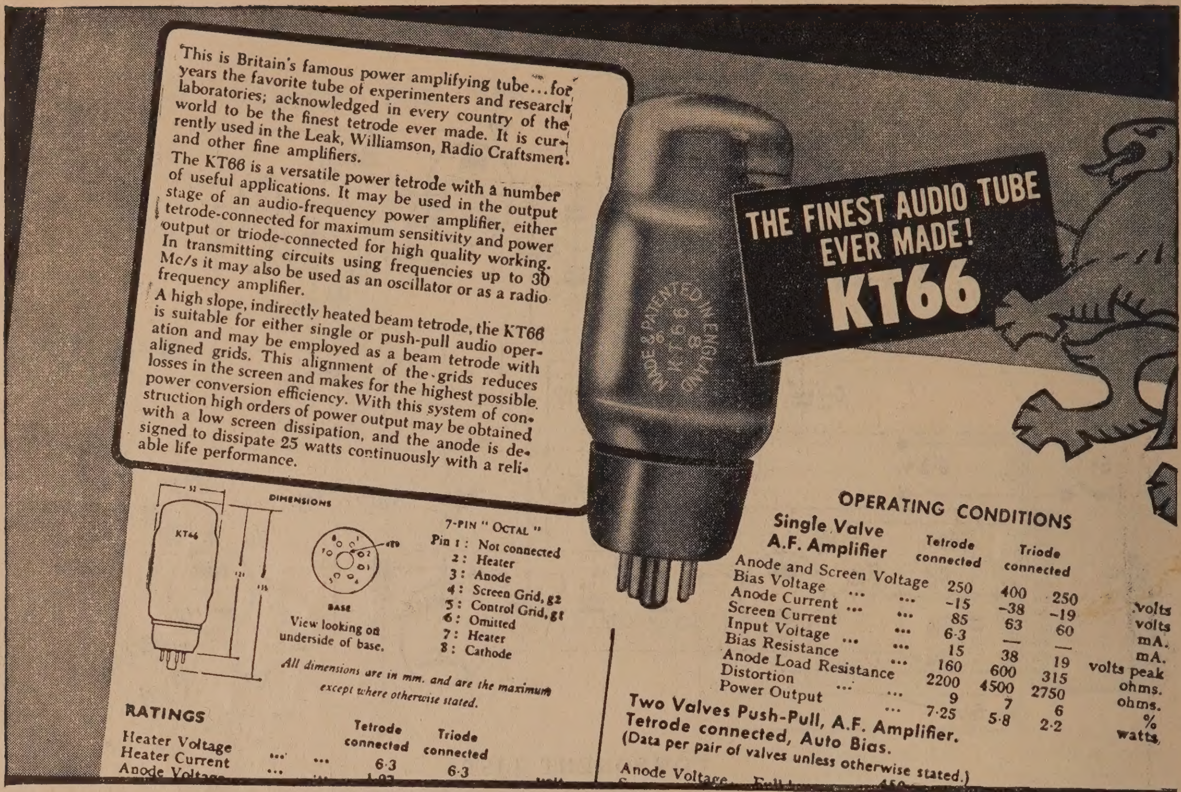
is not great enough for effective A.V.C. to be obtained, with the result that a manual gain control has to be used, as well as an audio volume control. It is an outstanding advantage of the system used here that this difficulty has been eliminated.

No volume control has been included on the tuner, since the output is intended to be fed to an audio amplifier, which will have its own volume control.

CIRCUIT DETAILS

Perhaps the most noticeable thing, on first glancing at the circuit, is the fact that a power supply has been included. The original tuner was built to go with the "R. and E. 807 Standard Amplifier," which was described in the September, 1952, issue, and because this amplifier had an 80 ma. power supply, which was fully loaded by the amplifier itself, it was imperative to use a separate supply for the tuner. In any event, a separate supply is preferable, since the majority of amplifiers have too high an H.T. voltage to apply to a tuner directly, so that a voltage divider is needed to obtain the 250 volts required for the tuner.

The four-valve circuit of the present tuner, moreover, draws rather more current than a conventional one, mainly on account of the 12 ma. or so taken by the 6SG7. Unfortunately, a small instrument power transformer, delivering 30 ma. at 150 volts, would not be suitable, because the heaters would be rather too much for the small winding provided on these transformers, and also because the H.T. voltage would not be sufficient. The alternative, which was decided upon, was to use a 60 ma. transformer of 280 volts a side. This enables a much more stable supply to be constructed. Variations in drain caused by A.V.C. action are minimized by placing a 15,000-ohm voltage divider across the supply, to act merely as a bleeder. Then, the required 250 volts are obtained by using a resistor for smoothing in place of a choke.



This is Britain's famous power amplifying tube...for years the favorite tube of experimenters and research laboratories; acknowledged in every country of the world to be the finest tetrode ever made. It is currently used in the Leak, Williamson, Radio Craftsmen and other fine amplifiers.

The KT66 is a versatile power tetrode with a number of useful applications. It may be used in the output stage of an audio-frequency power amplifier, either tetrode-connected for maximum sensitivity and power output or triode-connected for high quality working. In transmitting circuits using frequencies up to 30 Mc/s it may also be used as an oscillator or as a radio frequency amplifier.

A high slope, indirectly heated beam tetrode, the KT66 is suitable for either single or push-pull audio operation and may be employed as a beam tetrode with aligned grids. This alignment of the grids reduces losses in the screen and makes for the highest possible power conversion efficiency. With this system of construction high orders of power output may be obtained with a low screen dissipation, and the anode is designed to dissipate 25 watts continuously with a reliable life performance.

THE FINEST AUDIO TUBE EVER MADE!

KT66

DIMENSIONS

BASE

View looking on underside of base.

7-PIN " OCTAL "

Pin 1 : Not connected
2 : Heater
3 : Anode
4 : Screen Grid, g2
5 : Control Grid, g1
6 : Omitted
7 : Heater
8 : Cathode

All dimensions are in mm. and are the maximum except where otherwise stated.

RATINGS

	Tetrode connected	Triode connected
Heater Voltage		
Heater Current	6·3	6·3
Anode Voltage		

OPERATING CONDITIONS

Single Valve A.F. Amplifier	Tetrode connected	Triode connected		
Anode and Screen Voltage	250	400	250	volts
Bias Voltage	-15	-38	-19	volts
Anode Current	85	63	60	mA.
Screen Current ...	6·3	—	—	mA.
Input Voltage	15	38	19	volts peak
Bias Resistance ...	160	600	315	ohms.
Anode Load Resistance	2200	4500	2750	ohms.
Distortion	9	7	6	%
Power Output ...	7·25	5·8	2·2	watts,

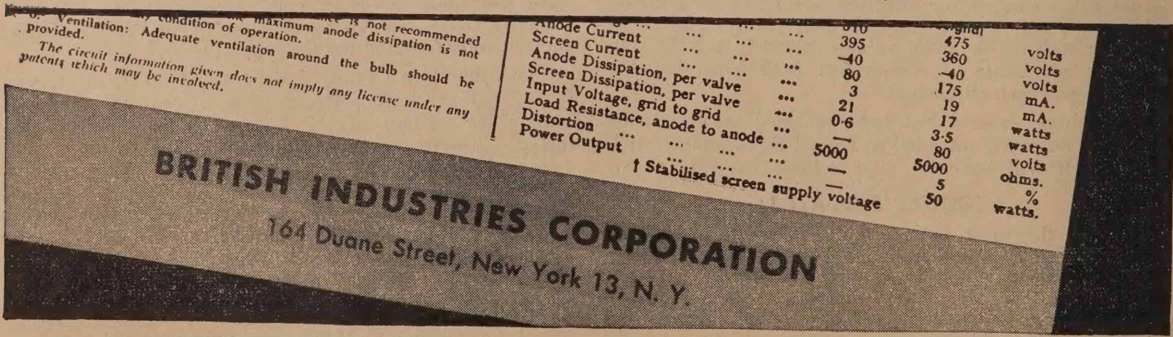
Two Valves Push-Pull, A.F. Amplifier. Tetrode connected, Auto Bias.
(Data per pair of valves unless otherwise stated.)

Anode Voltage

THE FAMOUS KT66 . . . IN USE ALL OVER AMERICA AND ACKNOWLEDGED TO BE THE FINEST BEAM TETRODE EVER MADE

IS AN Osram VALVE MADE IN ENGLAND

The photographic reproduction is taken from literature published in America by the British Industries Corporation and gives an entirely unsolicited tribute to this fine valve.



condition of operation. ... maximum anode dissipation is not recommended

Ventilation: Adequate ventilation around the bulb should be provided.

The circuit information given does not imply any license under any patents which may be involved.

Anode Current ...
Screen Current ...
Anode Dissipation, per valve ...
Screen Dissipation, per valve ...
Input Voltage, grid to grid ...
Load Resistance, anode to anode ...
Distortion ...
Power Output ...

395, -40, 80, 3, 21, 0·6, —, 5000, —, —

475, 360, -40, 175, 19, 17, 3·5, 80, 5000, 5, 50

volts, volts, volts, mA., mA., watts, watts, volts, ohms., %, watts.

† Stabilised screen supply voltage

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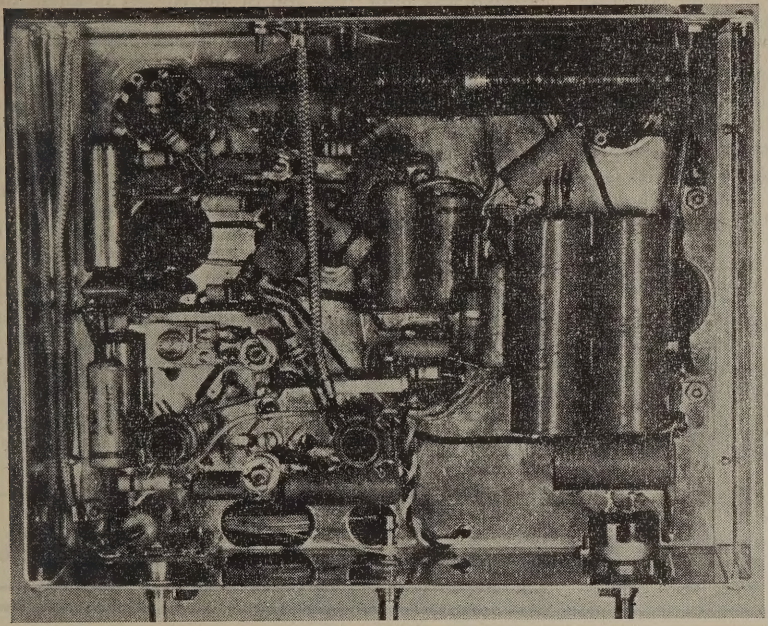
164 Duane Street, New York 13, N. Y.

BRITISH GENERAL ELECTRIC CO., LTD.

WELLINGTON AUCKLAND CHRISTCHURCH DUNEDIN



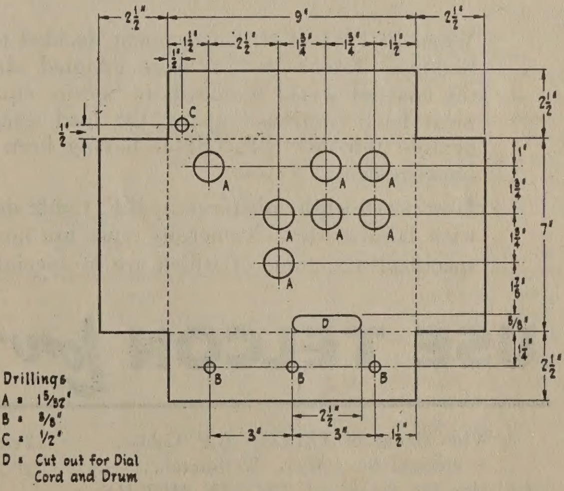
In order to save some small parts, and simplify the circuit a little, back bias is used for the ECH35, the EBF32, and the 6SG7. The voltage across the back bias resistor is also used as the A.V.C. delay voltage, by returning the load resistor of the A.V.C. rectifier to the upper end of the back bias resistor. This is in two parts, R_{12} and R_{13}, in order that half the total voltage developed can be used for the 6SG7, which requires only 1 volt, whereas the other two valves need 2 volts minimum bias. The pair is heavily by-passed by an electrolytic condenser to prevent hum from being injected into the grid circuits of the valves, with the possibility of introducing modulation hum.

The A.V.C. circuit is a trifle unusual, and requires some explanation. As shown, the A.V.C. load resistor is split into two parts, the upper being 1 meg. and the lower, 0.5 meg. From the upper end of the pair, comes a filter circuit feeding the A.V.C. voltage to the grid of the I.F. amplifier, through the lower end of the I.F. transformer secondary, in the ordinary way, and from the junction comes a second filter, which feeds a third of the total A.V.C. voltage to the mixer valve. The 6SG7 is not controlled by A.V.C. The idea of this unusual arrangement is that by reducing the A.V.C. voltage on the mixer valve, the gain of this tube is increased somewhat, with the result that it is easier to arrange that the output from the 6SG7 and its detector is about the same as that from the diode detector. In the final wiring, however, this system was changed to the conventional one, with the full A.V.C. voltage applied to the mixer as well as to the I.F. stage. To do this, R_2 must be decreased to 100k., and instead of taking it to the junction of the two portions of the diode load resistor, it is attached to the lower end of the primary winding of T_2, the second I.F. transformer. When this is done, the circuit is the ordinary one that is always used in conventional tuners.

The circuit shown was altered because it was found that when the local stations' signals were very strong, overloading occurred in the mixer stage, which resulted in audible distortion. However, where the tuner is to be used at some considerable distance from the nearest transmitter, the circuit would be quite satisfactory as shown, and would actually be an improvement over the more usual arrangement.

There is nothing particularly noteworthy about the circuit of the 6SG7, which looks like, and is, just a conventional resistance-coupled amplifier stage. Of course, the coupling condensers into and out of this stage are small, because although resistance-coupled, it has to handle only one frequency —455 kc/sec.—and this is so high that very small coupling condensers are all that are required. Large ones would actually be a disadvantage, because they would give the stage a response down to quite low audio frequencies, and would thus allow any hum voltages picked up by the wiring from the power supply circuit, or from the heater, to be amplified along with the signal. If this happened, it would almost certainly result in every signal being modulated with 50 or 100-cycle hum.

The 6J5 detector circuit is the ordinary infinite-impedance type, which is particularly useful in a case like this, because it is so well suited to resistance-capacity coupling. In spite of the high cathode load resistor of the detector, the plate current is so small that the cathode is only about 15 volts above chassis potential. This is well within the rating for D.C. voltage between heater and cathode, and need give no concern on that



score. However, some valves, which are quite satisfactory in conventional amplifier circuits, may not be so good here. It is not a very likely eventuality, but it is just possible that one may strike a 6J5 in which there is some leakage between heater and cathode. Should this be the case, the detector output is likely to be badly distorted, and also there would be a large hum in the output. The cure would be replacement of the 6J5.

The switch used to change over the output connection from one detector to the other should be a low-capacity type, in order to prevent the output of one detector feeding through the switch when it is only supposed to be accepting output from the other detector. A single section of a wafer switch would be satisfactory, or one of the small two-position switches with open contacts similar to those used on wave-change switches should be used. The type likely to be unsuitable for use here are the ordinary toggle or rotary switches intended for switching power supplies. These have quite high capacity between the contacts, and are not suitable for switching audio frequencies at all. They should never be used as change-over switches for going from "Gram" to "Radio," or similar purposes.

CONSTRUCTION

The chassis diagram, in conjunction with the photographs on the front cover, and in the body of this article, should give a good idea of the way in which the original was built. The top of the chassis is fairly well filled up with the main components, but there is no overcrowding, especially under the chassis, where space is important. The valves can easily be recognized in the cover photograph, except that the 6SG7 and the metal 6J5 look very similar. The one in the right-hand back corner of the chassis is the latter, and it can be seen that the 6SG7 is close handy to the first I.F. transformer, so that its grid lead may be nice and short. As can be seen from the under-chassis wiring photograph, the wiring has been compactly done, and it is owing to this that there is no necessity for any special shielding underneath. The wiring of the 6SG7 and 6J5 is confined to the vicinity of the valves themselves, so that there is little or no possibility of undesired feedback occurring. In the original there was not the slightest sign of instability in either section of the tuner, and the overall performance was all that was expected and hoped for. It is considered that the design of this tuner will find many adherents among those whose main equipment consists of a good amplifier and speaker, and who wish to make the most of them for radio reception on the broadcast band.

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An Excellent V.H.F. Aerial

While it is realized by most amateurs that high aerial gain can be achieved at very high frequencies, there is a comparative dearth of information on how to go about getting it. The article below describes one aerial system that is not too hard to build, is easy to feed, and really does give high gain. With it, a flea-powered transmitter lays down a signal 10 to 13 db. better than it would using a half-wave dipole.

INTRODUCTION

These days, the importance of the aerial in radio communication is very well appreciated, not only by those who use them commercially, but also by amateurs. One of the troubles about aerials, however, is that they take a great deal of high-powered mathematics to design, and unless someone has reduced the theory to a convenient set of design curves or formulae, most of us are not able to design them ourselves. This applies more particularly to the more complex types, which are usually the ones that have the greatest gain. Most of the text-books on radio give high-gain aerials only a passing mention, not deigning even to give suitable dimensions for a given frequency, so that lesser mortals, like ourselves, can at least have a go at scaling the dimensions up or down to the frequency we are interested in at the moment. Some high-gain aerials look ideal on paper, until it is found that they have an input impedance of seven ohms, or something equally removed from the 600, 300, 75, and 50-ohm figures so beloved of those who build them, simply because these have become semi-standardized for the characteristic impedance of transmission lines. Most of us want to use aerials, not design them, so that if the book does not "sew up" the difficult details about some unusual type, we naturally look on it as one to be left to someone else.

In the category just mentioned is the aerial which consists of a dipole and corner reflector, illustrated in the heading diagram. It looks beautiful on paper, unless, as is usually the case, no mention is made of the essential dimensions, and which is the best sort of reflector to use.

However, the curves given later in this article, together with a little description, about to be given, tell the full story of how a corner reflector can be worked out, and what is input impedance will be, so that suitable feeding arrangements can be made.

ABOUT CORNER REFLECTORS

We implied earlier that this article would describe something that would give real gain, so perhaps a few figures would not be out of order. The easiest to make and match can give power gains, referred to a half-wave dipole, of ten to thirteen decibels. That is to say, the effective power output of a transmitter using this aerial is ten to twenty times as great as if the same number of transmitter watts were fed into a half-wave dipole. Now whatever way you look at it, this order of gain is useful, to say the least. And the higher the frequency, the more useful it is. For example, if you are working on the 420 mc/sec. band, it is difficult to squeeze more than ten or twenty watts, at the outside, out of any of the currently available valves that will work at all at this frequency. More often, we find ourselves working with powers of one or two watts at the most, as this can be had without much difficulty. Having got a couple of watts, then an aerial which will make it sound the same to the man at the other end as 20 or 40, is worth having! Also, if you have such an aerial, it would be very poor policy not to use it for the receiver, too, and if this is done, you effectively give that same fellow at the other end ten to twenty times the transmitter power. Most of us have marvelled at the tremendous arrays used in early radar sets. They were large, heavy, and costly, both directly and indirectly, but they were worth their weight in gold, especially where the transmitters used were the most powerful that could be made, for the frequency in use. Even a modest 3 db. aerial gain, when used for both transmitter and receiver, was equivalent to doubling the transmitter power twice over and resulted in a large improvement in the detection range of the equipment.

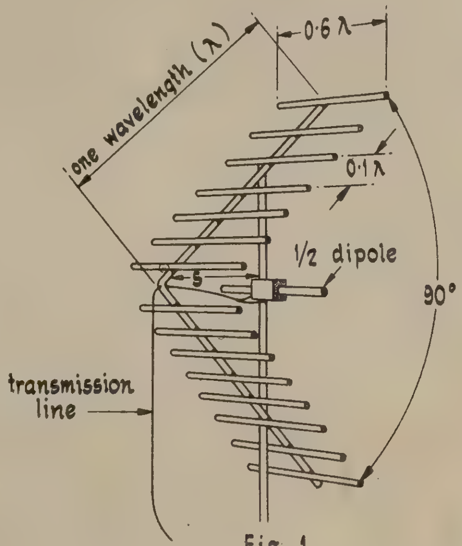

Fig. 1

In amateur, or any other communication, the benefits of aerial gain are similar, and on very high frequencies, aerial improvement offers the only practical way of improving a station's performance. To repeat, then, the simplest type of corner reflector can give 19 to 13 db. improvement over a dipole. The more ambitious ones can give almost twice this amount, but one pays for it handsomely in increased difficulty of making suitable matching arrangements between the aerial and the transmission line, and in greater size.

Ideally, the reflector should consist of a perfectly conducting sheet (e.g., of copper) extending to infinity in directions parallel with the dipole, and having infinitely long arms. In this case, of course, the gain would be infinitely great, but to come down to practical cases, it is found that very little performance is sacrificed if the sides of the reflector are only slightly wider than the length of the dipole, and if the sides are a wavelength or more long. It is better, of course, if the reflector sides are two or three wavelengths long, but not so much better that we need lose any sleep over it. Unfortunately, even when the wavelength is quite short, a structure like this would be large and heavy if made of solid sheet material. It would also offer a great deal of wind resistance, making it difficult to mount on anything but a flat roof-top or a very solidly constructed tower. But luckily, the performance is very slightly impaired if the reflector is made of netting, such as ordinary chicken netting, provided the holes are small compared with a wavelength at the working frequency. This removal of material can be taken even further, and the sides of the reflector reduced to a row of rods or wires, parallel with the dipole, and not more than a tenth of a wavelength apart. These modifications greatly reduce windage and weight, and make it possible to build a structure light enough to be put on top of a mast, and rotated.

Referring to the curve for the 90° reflector, it is seen that as the dipole is moved out from the apex of the reflector, the gain rapidly increases, until it reaches approximately ten times, after which it flattens off, and no further increase in the spacing between the dipole and the apex makes very much difference to the gain. The critical spacing, as it might be called, is 0.175 wavelengths, so that as long as the spacing is this much or more, it does not matter so far as gain is concerned, so that we are then free to choose the spacing to suit other considerations. Looking now at Fig. 3, we see that at a spacing of 0.35 wavelengths, the input impedance of the dipole is the same as without the reflector, so that if we want the greatest possible ease of matching, we can fix the spacing at this, and use a folded dipole, fed by 300-ohm ribbon or other 300-ohm balanced line. The proportions of the whole thing are then fixed, and we can proceed to scale the dimensions to suit the frequency we intend to operate at.

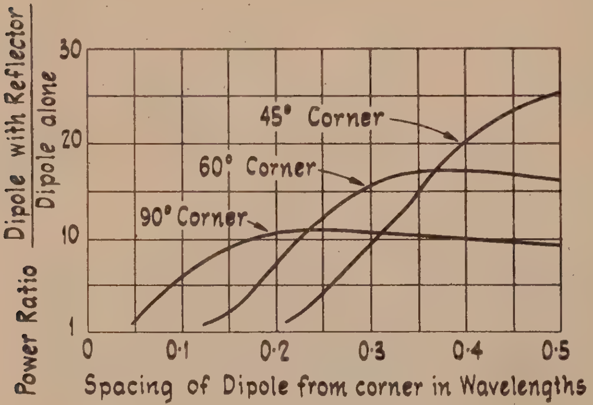

Fig. 2

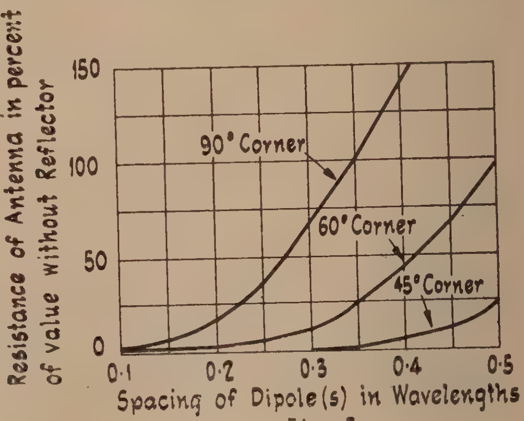

Fig. 3

Having decided, then, that the reflector will be just over half a wavelength wide, and between one and three wavelengths long, there remain two things about it that can be varied to alter the gain and input impedance. These are the angle included by the sides, and the distance of the dipole from the apex. In general, the smaller the included angle, the greater the gain, and the lower the impedance; and the nearer the dipole to the apex, the lower is the impedance also. One of the difficulties about multi-element Yagi arrays is that as they are designed for greater and greater gain, so does the feed-point impedance become lower and lower, until it becomes only a few ohms, and the difficulty of feeding the aerial is very great. With the corner reflector, however, a wide variety of input impedances can be had, for any particular angle, simply by moving the dipole along the axis, nearer to or farther from the apex. The impedance can be varied in this way from a small fraction of the normal impedance of the dipole, to two or three times that figure. The actual impedance in a particular instance will depend on the dipole itself. For instance, an ordinary half-wave dipole has an impedance of about 72 ohms, so that if this type of dipole is used, the graph of Fig. 3 will give the factor by which 72 ohms must be multiplied to give the actual impedance. A folded dipole, on the other hand, has an impedance of some 300 ohms, and if one is used, the actual impedance is found by multiplying this figure by the factor given by Fig. 3.

DIMENSIONS FOR THE 2-METRE BAND

About the lowest band at which it is normally feasible to use such an aerial is the 2-metre amateur band. If we make the length of the sides one wavelength, the spacing of the dipole from the corner 0.35 wavelengths, and the length of the rods 0.6 wavelengths, we arrive at the following set of dimensions.

Length of reflector sides (λ)	6 ft. 9 in.
Length of reflector rods (0.6 λ)	4 ft. 1 in.
Length of dipole (0.95 λ/2)	3 ft. 3 in.
Spacing between reflector wires (0.1 λ)	8 in.
Distance between dipole and corner (0.35 λ)	2 ft. 4 in.

As can be seen from the above, the structure is not particularly large, and since light copper tubing or heavy wire can be used for the rods of the reflector, it need not be very heavy, either. A suggested way of constructing it is shown in Fig. 1. A pair of light wooden booms are used for the reflector proper, while a vertical piece of wood, passing through the desired position of the dipole makes it into a rigid triangle. This can be reinforced at the corner with gussets of wood, and the vertical piece can be made heavy enough to be strapped to the top of a mast, or it can even be the top of the mast itself. It is assumed, of course, that rotation will not be required. However, for anyone who has a rotating platform with a low-frequency Yagi attached to it, it should not be difficult to attach the corner reflector firmly to it,

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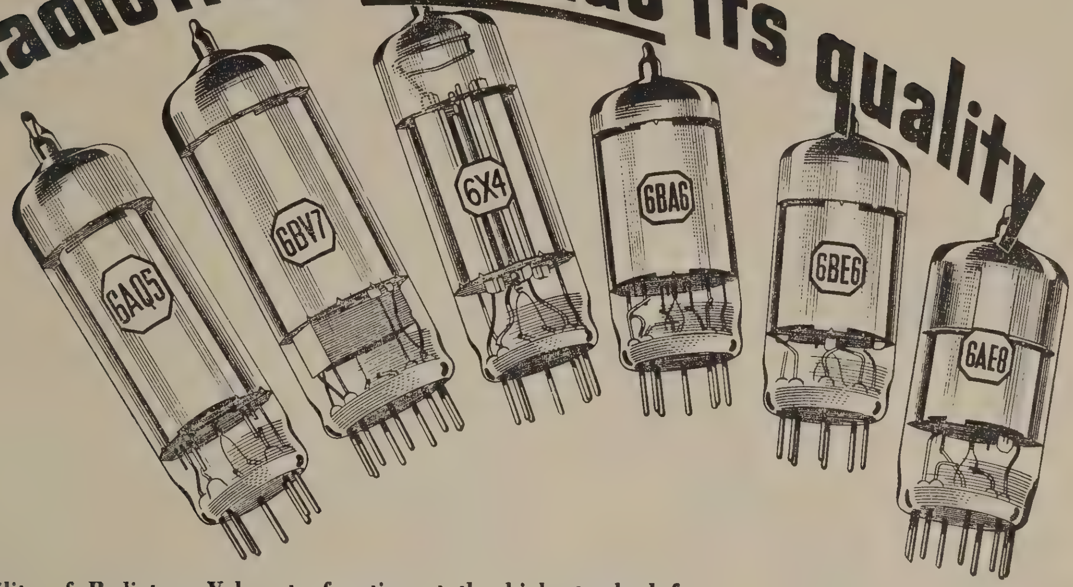

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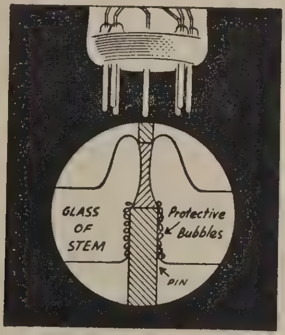

A casual observation shows that the glass base, in a molten state, has been moulded around the leads. However, what the eye does not see is a group of protective gas bubbles surrounding each pin to act as a shock absorber to any inward or outward movement of the pins. This process is made possible by the fact that in Radiotron Valves only carefully selected wire, having a fixed gas content, is used. Molten glass is forced around these pins, and the heat of the operation causes the absorbed gases in the wire to come to the surface and be trapped between it and the glass as shown.

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so that it, too, can be rotated. It may be a bit premature, as yet, but when we get television, those who are a considerable distance form the transmitter, in what is termed a "fringe area," could very well improve their reception tremendously by putting up one of these corner reflectors, and in this case, it will not need to be rotated, once the correct direction has been found.

For higher frequencies than the 144 mc/sec. band, such as 420, the corner reflector really comes into its own. At the centre of this band a wavelength is only 27 in. long, so that the same aerial as before would come out to the dimensions below.

	in.
Length of reflector sides	27
Length of reflector rods	16¼
Length of dipole	12¾
Spacing between reflector rods	2¾
Distance between dipole and corner	6¾

These dimensions look something small enough to carry around on top of a walkie-talkie outfit, let alone putting it on top of a pole! It becomes a moot point whether at this frequency it would not be worth while going for one of the 60° or 45° corners, with their much higher gain still. Unfortunately, if the very high gains shown in the graph in Fig. 2 are to be realized in practice, it is necessary to make the arms of the reflector much longer—two or three wavelengths, according to the pundits. But even 2½ wavelengths at this frequency is only 5 ft. 7½ in., which is still less than the 2-metre aerial worked out above. It would pay us, therefore, to construct a V-reflector, say with 7 ft. arms, and to space the wires or rods by 2¾ in. The reflector would then be suitable for either 144 or 420 mc/sec. or for anything in between or higher, should such a necessity ever arise. Then, by changing the distances along the supporting piece at which the arms of the V are bolted, the angle can be changed from 90° to 60° or 45°. If, as is likely, the position of the supporting member is not suitable for supporting the dipole for the higher frequency, a small cross-piece can be fitted at the right place. Then, simply by altering the angle and fitting the appropriate dipole assembly, the aerial can be made to work on either band. In short, there are limitless opportunities for those who like experimenting with aerials. A 45° corner, giving a gain of some 25 times, or 14 db., would need the dipole spaced about half a wavelength from the corner, and the input impedance would be a quarter of the dipole impedance. In the case of an ordinary dipole, this would make the input impedance only 18 ohms, which is rather low for convenience in matching to a line. However, if a folded dipole is used instead, the input impedance would be 72 ohms, the same as a single dipole without the reflector. The best way of matching this to the 300-ohm twin-lead, would be to use a quarter-wave matching transformer. This consists simply of a quarter-wavelength of transmission line, made to have the correct characteristic impedance, according to the following simple calculation. If a quarter wave line is connected between two impedances, there will be a perfect match if the characteristic impedance of the quarter-wave section has a value of

$$Z_c = \sqrt{Z_1 . Z_2}$$

In our case, Z_1 is 300 ohms, and Z_2 is 72 ohms, so that

$$Z_c = \sqrt{300 \times 72} = 150 \text{ ohms.}$$

All we have to do now to complete the job is to construct a quarter-wave section of line from copper rod or tube, and connect it between the dipole and the 300-ohm feeder. The charts or formula in the handbooks tell us that a spacing of 1.75 times the wire diameter will give an impedance of 150 ohms. Thus, if we make our matching section of ¼ in. diameter copper rod or tube, and space it 7/16 in. centre-to-centre, it will have the correct impedance to provide an exact match. If the matching section, which can be made quite rigid, is used to support the folded dipole at one end, and is itself supported somewhere near the middle, it can be adjusted in its support so as to vary slightly the distance between the dipole and the corner. This will give a fine control over the matching, and if a standing-wave indicator is used, setting up the aerial will consist of nothing more than adjusting the position of the dipole to give minimum standing-wave ratio.

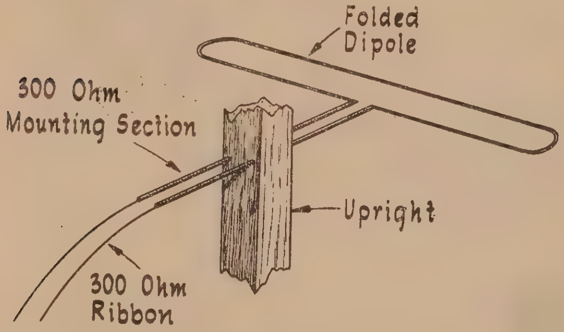

Fig. 4

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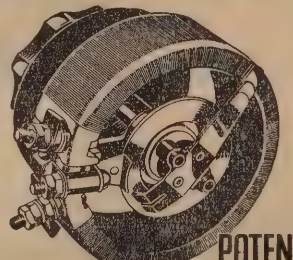

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Hitting the V.H.F. Bands

One of the major difficulties confronting the amateur transmitter who wishes to use the V.H.F. bands is the difficulty of getting on them with anything better than a modulated oscillator. The latter is quite outmoded these days for the six-metre band, and, really speaking, for the two-metre band also. For the 420 mc/sec. band, self-excited oscillators seem to be still the easiest things to get going, but here, the difficulty is finding the band. The scheme briefly described below shows how a single master-oscillator can be made to act as the frequency determining circuit for output on all three of these bands, even 420 being reached by only two frequency-multiplier stages.

INTRODUCTION

While many amateur transmitters will concede that the V.H.F. bands are ideal for short-haul amateur communication, and in theory could do a great deal to ease the undoubted congestion on the H.F. bands, the difficulty seems to be to get amateurs to have a try at V.H.F. working. This has always seemed surprising to us, possibly because in the early days of amateur radio, which we well remember ourselves, the emphasis was on experimental work rather than on DX working or local contacts. These days, the emphasis seems to have shifted from experimenting to these other phases of amateur operation; this is understandable, but it is directly responsible for the crowded state of the high-frequency amateur bands. It appears to be responsible, too, for the unwillingness of many "hams" to shift some of their operation to the V.H.F. bands. The reason is, of course, that commercial receivers are not available for these bands, and so both receivers and transmitters must be built by anyone wanting to work them. To those who are experimentally inclined, this is at once a challenge and a joy, for the born experimenter is never happier than when building something new and making it work. But as we said earlier, the number of "experimental" amateurs seems to have declined, with the result that those beautifully wide V.H.F. bands are left almost untenanted.

This does seem a pity, for there are as many thrills to be had in working V.H.F. DX over a few hundred miles as can be derived from DX on the H.F. bands, over several thousand miles. Besides, these days, it is virtually only a matter of waiting for the right conditions to turn up (given a good transmitter and receiver) in order to "work" any part of the world, but V.H.F. is still largely unexplored territory so far as long-distance communication is concerned.

Several years ago, building receivers or transmitters for the 2-metre band was rather a hit or miss affair, since really suitable valves were not available for working on such high frequencies, but with the wide range of V.H.F. valves available today, this difficulty no longer applies. To a considerable extent, it still exists when we come to the 420 mc/sec. band, but even here, there are a number of valves which will work well, so that there is no basic technical reason why 420 should not be regularly worked by as many as like to turn their hand to a little unorthodox construction. The 420 band can still be said to be largely in the modulated-oscillator-cum-superregenerative-receiver stage as far as the amateur is concerned, but as we will attempt to show, this need not be so any longer. Such elementary technique may at first sight seem the easiest and quickest approach to this band, but using it brings in other difficulties, and it is a moot point whether the man wishing to give 420 mc/sec. a try would not be better off in the first place to approach it from the master-oscillator-superhet angle. But enough of introductory "blurb" and on with the practical story.

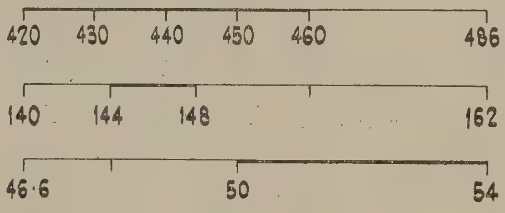

Fig. 1

SIGNAL SOURCES FOR V.H.F.

We are quite sure that one thing which has militated against the popular use of the V.H.F. bands is the fact that they are not in simple harmonic relationship to the "ordinary" H.F. bands. For instance, pre-war, when the next highest band above 10 metres was 56-60 mc/sec., anyone with a 10-metre rig had only to lay on one further stage of frequency doubling, and he was there, with a minimum of trouble, and crystal-controlled, at that. No trouble about "finding the band," and economical besides, since the same crystal as was used for 10 metres would put a signal into the five-metre band too. Now, however, such a happy state of affairs no longer exists; 50–54 mc/sec. is not obtainable by frequency multiplication from any of the lower bands, and this discourages many from attempting the band. But basically, why should it? Many amateurs these days use variable-frequency oscillators instead of, or in addition to crystals, and with a good stable V.F.O., there is no difficulty about hitting 50–54 mc/sec. For example, suppose we already have a V.F.O. working on the 80-metre band, followed by three doublers, the last giving output on ten metres. This represents a total frequency multiplication of eight times. If we divide 50–54 by 16, we get 3.125–3.375 mc/sec., so if we originally built our V.F.O. to cover 3.125 to 4.0 mc/sec. instead of from 3.5 to 4.0, all that would be required to obtain output on the six-metre band would be to retune the doubler stages, and bring in an extra one, which could be permanently tuned to the six-metre band.

Of course, this solution is not of much assistance when the V.F.O. is already built, and in any case is not much help with regard to the other two V.H.F. bands. It does, however, indicate that a specially-built V.F.O. might hold a possible solution.

By a lucky chance, the three V.H.F. bands do lie in quite close relationship to each other. Although the relation between them is not entirely clear-cut, as it would be if they were in exact harmonic relationship, it is close enough to be of practical utility. The facts are these:

(1) Frequency tripling from the 2-metre band takes us plumb into the middle of the 420–460 mc/sec. band, or, more precisely, to the range 432–444 mc/sec.

(2) The lower end of the 6-metre band can be multiplied by nine times into the high end of the 420 mc/sec. band. From 50 to 51.1 mc/sec. covers 450 to 460 mc/sec.

This relationship is illustrated in Fig. 1, which shows the situation more clearly than any figures can do. From this figure, it will be seen that an oscillator covering the range 46.6 to 54 mc/sec. will allow operation over the whole of the three bands. Furthermore, only two stages of frequency multiplication would be needed, each stage being a tripler. Three scales on the oscillator tuning condenser, marked somewhat as in the diagram, would enable an entry to be made into any band without difficulty, and without recourse to Lecher lines as the only frequency-measuring device.

Fig. 1 also gives a clue as to the crystal frequencies needed if crystal control were to be used rather than a V.F.O. Further frequency multiplication would be needed, of course, because suitable crystals would have much lower frequencies than those we have been discussing. At least two stages will be needed, making possible multiplications of 4, 6, or 9 times before reaching the band 46.6–54 mc/sec., which we can regard as our basic V.H.F. band. The following three tables show the crystal frequencies needed for each of these three types of multiplication. The multiplying factors mentioned at the head of each table refer to those needed to reach the basic band from the crystal.

TABLE 1 (4 times)

Xtal Freq. mc/sec.	6m. Band. mc/sec.	2m. Band mc/sec.	420 Band mc/sec.
(a) 11.6	—	—	420
(b) 12.0	—	144	432
(c) 12.3	—	148	444
(d) 12.5	50	—	450
(e) 12.7	51.1	—	460
(f) 13.5	54	—	—

TABLE 2 (6 times)

Xtal Freq. mc/sec.	6m. Band. mc/sec.	2m. Band. mc/sec.	420 Band mc/sec.
(a) 7.7	—	—	420
(b) 8.0	—	144	432
(c) 8.2	—	148	444
(d) 8.3	50	—	450
(e) 8.5	51.1	—	460
(f) 9.0	54	—	—

TABLE 3 (9 times)

Xtal Freq. mc/sec.	6m. Band. mc/sec.	2m. Band. mc/sec.	420 Band. mc/sec.
(a) 5.185	—	—	420
(b) 5.3	—	144	432
(c) 5.481	—	148	444
(d) 5.5	50	—	450
(e) 5.679	51.1	—	460
(f) 6.0	54	—	—

All these tables have been laid out in such a way that frequencies (a) to (e) give the range required for the 420 mc/sec. band alone. Similarly, (b) to (c) is the range needed only for the 2m. band, while (d) to (f) is the range for the 6m. band alone.

Similarly, for the two higher bands, crystals between (a) and (e) will give the required range, and for the two lower bands, the range is from (b) to (f). In cases where the first multiplier stage may either double or triple, Tables 2 and 3 together give the required crystal frequencies.

These tables should be useful for seeing at a glance whether a crystal on a certain frequency is usable for reaching a particular band. For instance, in a recent advertisement in our contemporary, *Break-In,* an advertiser announced that he had crystals on 8475 and 8500 kc/sec. Reference to Table 2 shows that the first of these would multiply to the 6-metre band, would miss the 2-metre band, and would hit the 420 band. The second frequency would work similarly, but would be quite near the high edge of the 420 band, landing us on 459 mc/sec.

WHAT SORT OF V.F.O.?

All of the above suggests that if we are to arrive at these three bands via the V.F.O., it will need to be one specially designed for the purpose. It does not have to be, as we have already pointed out, but it would be much better so. Ordinarily, one would think in terms of

(Continued on Page 48.)

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U.H.F. Instrumentation

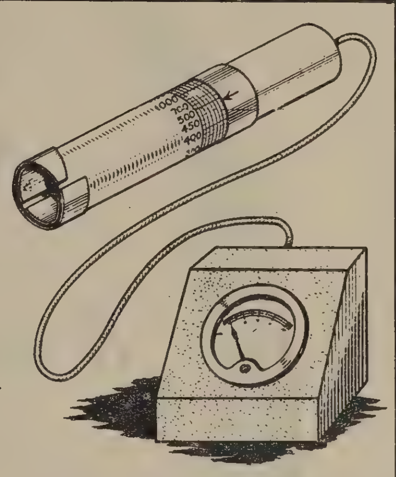
Part I.—A U.H.F. Absorption Frequency Meter

By the Engineering Department, Aerovox Corporation

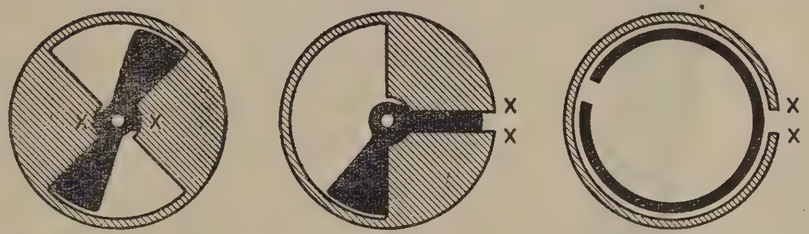
The coming-of-age of the ultra-high frequency portion of the radio spectrum, brought about by the recent freeze-lifting on U.H.F. television permits and the activation of the Citizens Radio Service, brings with it many problems in U.H.F. instrumentation. Although the industry has foreseen the expansion into this region for a considerable period of time, simple test equipment for use at these frequencies has been noticeably lacking. For this reason, the TV technician, experimenter, and radio amateur working at frequencies between 300 and 1000 megacycles per second may find himself in the position of having to construct much of his own test equipment. Special techniques will be required since this range is the clumsy "transition region" between the more familiar V.H.F. practices and the "plumbing-and-hardware" techniques of the microwaves. This article, as well as several which will follow from time to time under this series, is intended to provide a useful service to its readers in this respect by describing simple basic equipment which will be needed for servicing U.H.F. television and performing experimental work at the lower U.H.F. range.

The experimental U.H.F. absorption meter described here can be constructed without special tools and represents the most simple device available for determining the frequency of U.H.F. signal sources. It appears as shown in Fig. 1.

Anyone who has used an absorption meter at low frequencies is familiar with the utility of such a device for rough frequency determinations. As used for low frequency applications, it usually consists of a parallel L-C circuit capable of tuning over a wide range and calibrated in terms of resonant frequency or wavelength. It is used to determine the unknown frequency of a signal source by loosely coupling it to the output of the signal source and noting the effect on the latter as the frequency meter is tuned to the unknown frequency. This effect may be either an increase in the plate current or a decrease in the grid current of the source oscillator as the frequency meter is tuned to resonance. This interaction is caused by the increased loading effect produced by the energy absorption of the resonant circuit. The absorption meter may also be made self-indicating by coupling an indicator, such as a small incandescent bulb or a crystal rectifier-meter combination, to it. An absorption meter is usualy used for rough frequency "search" work.



UHF FREQUENCY METER
FIG. 1



BUTTERFLY

SEMI-BUTTERFLY

SPLIT CYLINDER

X X = High-impedance points

UHF TUNER CIRCUITS
FIG. 2

U.H.F. DESIGN CONSIDERATIONS

For use in the presently expanding portion of the U.H.F. spectrum, an absorption frequency meter should have the following characteristics:

(a) Tune from about 300 to at least 1000 megacycles.

(b) Self-indicating for use with non-metered local oscillators, etc.

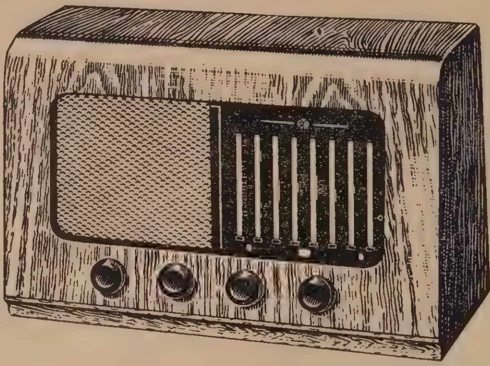
(c) Compact form factor to permit use in restricted space.

(d) Rugged construction for good frequency stability.

(e) High "Q" for sharp resonance indication.

For our present purpose the frequency meter should also be easy to construct and calibrate.

A survey of the types of tuned circuits available



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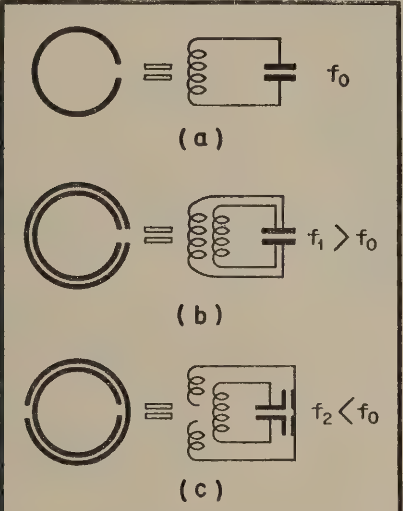
Radio and Television

for U.H.F. use indicates that several, such as the butterfly, the semi-butterfly, and the split-cylinder tuners, which are illustrated in Fig. 2, fulfil most of these requirements. In the form described in this issue, the split cylinder tuner has the added advantage of being the most easily constructed. For this reason it was chosen as the basis for our present design.

The split cylinder tuner, attributed to Karplus,[1] is one of the types of U.H.F. resonant circuit which is proving popular for use in U.H.F. television converters. It consists of two cylindrical metal tubes mounted concentrically so that one is free to rotate within the other. Both tubes are split lengthwise and have diameters such that the spacing between them is only a few thousandths of an inch. The manner in which wide range tuning is accomplished with this combination is shown in Fig. 3. The equivalence of one of the split cylinders to a conventional L-C resonant circuit is illustrated in Fig. 3a. The gap corresponds to the capacitance while the solid portion opposite it is equivalent to a one-turn inductance. In 3b the effect of placing a similar ring close around the first, with the gap in the same position, is shown. In this position, the resonant frequency of the combination is maximum, since the inductances of the two rings are essentially in parallel, while the total capacitance is not appreciably changed. When the outside ring is rotated 180 degrees, as in Fig. 3c, the effective capacitance of the resonant circuit is greatly increased by the presence of the inner ring across the gap of the outer one, which has the effect of a split-stator condenser. The inductance of the tuned circuit is also maximum in this position, since the split portion of the inner cylinder adjacent to the inductive portion of the outer one has little effect. Thus, the resonant frequency of the combination is at a minimum when the rings are in this position. Therefore an appreciable tuning range is covered by 180-degree rotation of the movable cylinder. For simple split-cylinders, however, the tuning is not linear with rotation, but becomes very rapid at the high frequency end of the range where the movable cylinder first crosses the gap of the fixed one.



REPRESENTATION OF SPLIT-CYLINDER TUNING

FIG. 3

CONSTRUCTION

As usually employed for U.H.F. television, the split cylinder tuner is constructed with the outer cylinder fixed in a housing and the inner ring is free to rotate within it on a tuning shaft supported on bearings mounted in the ends of the housing. The close spacing between the two must be maintained accurately, requiring considerable precision machine work. The construction of the absorption frequency meter described here is a modified version of this tuner, suggested by Kumpfer. In this form it is easier to construct and has a form factor well adapted to this application, as shown in Fig. 1. It is made by providing the tuner with a handle consisting of an extension of the inner split cylinder and attached to it only by a narrow section of the brass tube from which both are made. The outer ring is separated from the inner one by a dielectric tube which fits snugly over the inner ring and tubular handle and acts to space the two split cylinders. Tuning is then accomplished by rotating the dielectric tube around the metal tube. Means are provided to assure axial alignment of the two split cylinders and a graduated scale is marked on the dielectric tube for calibration of the frequency meter. The tuning range is about 350 to 1100 megacycles. To avoid the rapid variations of frequency with rotation at the high end, the outer cylinder has been shaped so that the variation of the capacitance across the gap of the inner ring is not so rapid as is the case when the tuning ring is left full width. The resulting tuning curve is shown in solid lines in Fig. 4, when the uncorrected curve is shown in

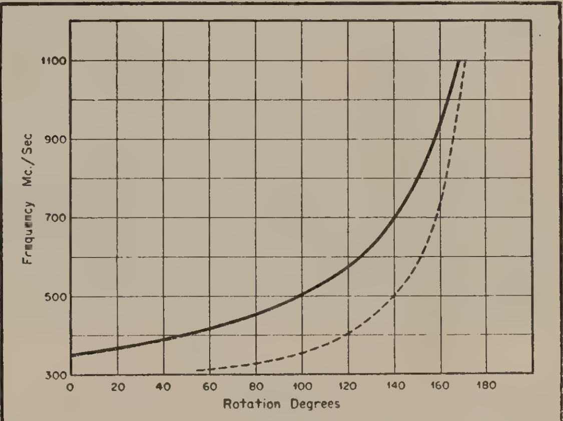
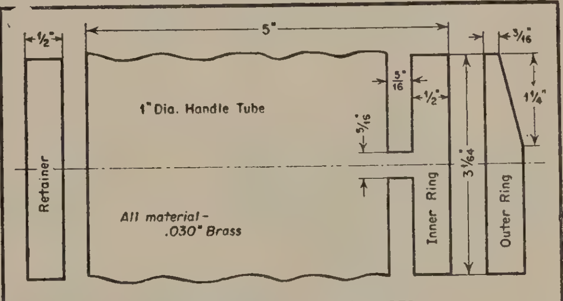


FIG. 4

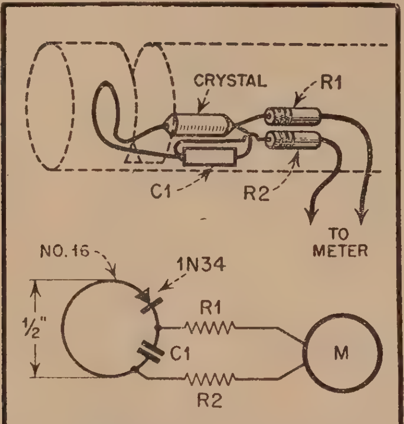


DEVELOPED VIEW OF METAL PARTS

FIG. 5

dotted lines. By further shaping of both cylinders, the tuning could probably be made essentially linear, but at some sacrifice in total coverage.

The dimensions of the frequency meter parts are shown in Fig. 5 which represents the metal tubular parts spread flat. The body of the frequency meter and the inside cylinder are made from a single piece of standard brass tubing 1 inch in diameter with a .030 inch wall. The overall length of the brass tube is 5 inches. The inside resonating ring is ½ in. wide and is separated from the rest of the handle tube by a 5/16 in. gap except where it is joined to it by a portion of the brass wall 5/16 in. wide diametrically opposite the slot, which is ⅛ in. wide. These cuts in the brass tube can be made with a hack-saw, after which the edges are dressed smooth with a file.



R1, R2 - 1000 OHMS (AEROVOX Type 1097)
C1 - 25 MMFD., (AEROVOX Type 1468)
CRYSTAL - 1N34

METER INDICATOR DETAILS
FIG. 6

A retaining collar of brass sheet stock or tubing is sweated around the end of the handle tube opposite the split ring to provide a stop for the dielectric tube. This collar may be scribed with an indexing mark for calibration of the frequency meter.

The outside tuning ring may be made from a piece of .030 in. flat brass stock bent into a split tube with a ⅛ in. gap, or it may be fabricated from a slightly larger size of tubing and formed to fit well around the inner ring after splitting. The dimensions of this ring, after shaping for better tuning characteristics, are given in Fig. 5.

The dielectric tube which spaces the two split cylinders is fabricated by winding two layers of thin wax-paper around the handle tube, extending from the edge of the split cylinder. This tube is cemented at the seams with Duco cement so that it will turn smoothly on the brass tube. A layer of white bond paper is then cemented over the wax-paper and the outside tuning ring is fastened to the tube thus formed so that its position coincides with the inner ring when the edge of the dielectric tube is held against the retaining collar. A piece of graph paper is cemented to the dielectric tube up to the retaining collar to provide a calibration scale.

The frequency meter can be used in this form to determine the frequency circuits which have metered plate or grid circuits, or ones where a meter can be conveniently inserted. For non-metered circuits, however, the frequency meter can be made self-indicating with little additional effort by mounting a coupling loop and crystal detector circuit within the handle so that it samples the magnetic field within the resonator. The rectified current, which increases abruptly when the frequency meter is tuned to resonance, is indicated by a meter connected to leads brought out through the handle. The circuit of this indicator, as well as a sketch of the physical arrangement, is shown in Fig. 6. Any meter with a full-scale reading of one milliampere or less will be suitable. If a microammeter is used, less coupling is required between the frequency meter and the circuit being measured, resulting in better accuracy.

CALIBRATION

The absorption meter must be calibrated against a standard such as a calibrated U.H.F. signal generator or a variable-frequency U.H.F. oscillator in turn calibrated by means of an accurate Lecher wire system. Enough points should be taken to allow marking a frequency scale on the graph paper attached to the paper tube. After the scale is calibrated, the exposed portion of the paper tube is covered by a smooth layer of transparent cellulose tape to protect it and prevent moisture absorption.

REFERENCES

(1) E. Karplus, Wide Range Tuned Circuits and Oscillators for High Frequencies, Proc. I.R.E., July, 1945.

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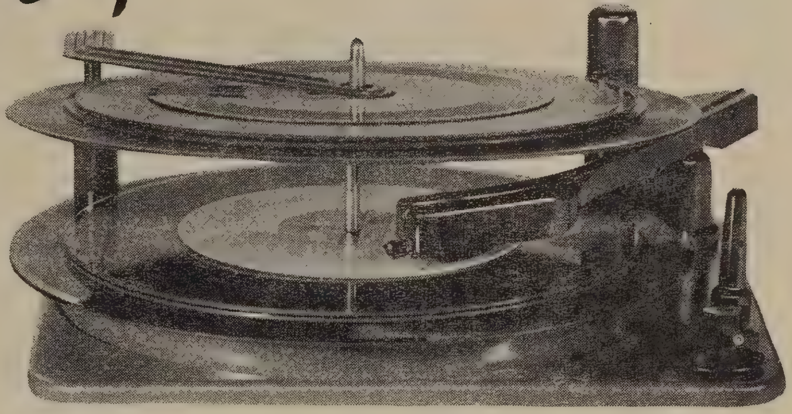

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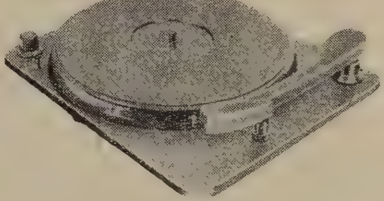

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V.H.F. Radio Telephone

Over the last four or five years one of the most outstanding new developments in the radio field has undoubtedly been the V.H.F. radio telephone. From a comparatively unknown quantity its use has spread like wildfire to become another of the many commonly accepted conveniences in our modern way of life. Taxi companies in the bigger towns and cities are larger users and it has also found its way into numerous small country cab services throughout the country to a surprising degree. Other users include power boards, veterinary groups, transport operators, and similar concerns. Among the radio-minded fraternity there is quite a lot of interest in the sets, quite a lot of mystery, and quite a lot of misconceptions—a trio of descriptions that could be applied to modern women and those of older vintage, if we can believe our fathers!

The modern V.H.F. radio telephone in New Zealand is almost exclusively an amplitude modulated receiver-transmitter operating in the 100–108 mc/sec. band. Both receiver and transmitter are crystal-controlled so that from the operator's point of view controls are at a minimum, generally being limited to a volume control, on/off switch, a muting control, and a press-to-talk switch on the microphone. The crystals are generally prepared for a frequency in the region of 9 to 13 mc/sec. (depending on the final frequency required) and then multiplied by way of a chain of multiplier valves to give the final frequency in the 100 mc/sec. band.

The amount of multiplication involved varies with different manufacturers' sets, but usually works out about eight or nine times.

The receivers follow normal superhet principles, making due allowance for the high frequency on which they operate. Three or four stages of I.F. amplification are common, followed by detection, noise-limiting, or muting, and then audio. The more sensitive sets employ an R.F. stage and there is, of course, the local oscillator which is crystal-controlled on frequency and multiplied up until the stage where it is injected into the mixer to beat with the incoming signal thus giving I.F. in a conventional manner. More recent model receivers have double conversion, the crystal being used to provide two different I.F. frequencies, the first being comparatively high and the second more nearly usual, one particular make of imported set having a first I.F. of somewhere about 12 mc/sec., depending on the final frequency required, and then a second I.F. of 2.9 mc/sec. This arrangement has the very real advantage of giving good image suppression with the high first I.F., plus the high amplification with stability of the low second I.F.

In so far as New Zealand radio-telephone schemes are concerned, a system of simplex operation is mainly used. That is, transmitter and receiver are on the same frequency, but duplex facilities can be readily provided should the occasion arise. A common aerial is provided and an aerial relay used to switch it across from transmitter to receiver. The roof-top aerial is provided and an aerial relay used to switch although as many people may have noticed numbers of taxi-cabs have side-mounting aerials. Some of these are much more scientific than others, notably that type with the very thick diameter bottom section. In the main, however, the roof-top aerial is the better proposition and the side-mounting types are usually supplied much against the grain by agents as a sop to the owner of a nice new car who can't bear to think of that hole going through the roof!

Power supplies are a bone of contention and fall into two groups—motor generator and vibrator. The motor generator scores on the count of reliability; and, in fact, on sets having a high transmitter output where sizeable current requirements have to be met, is by far the most practical method. They go for long periods without attention but, when necessary, a clean out, lubrication, and new brushes brings them up to scratch again. The vibrator wins on the score of efficiency and mechanical quietness. Where low drain from the battery is important and where H.T. current requirements are low, the vibrator finds universal use. The modern radio-telephone employing as many as fourteen valves draws as little as 3.5 amps from a 12-volt battery, which is pretty good going.

Transmitter powers vary from 15 watts in the bigger sets to 1.5 watts in the more utility models. This low power may seem very small, but with an efficient aerial gives adequate results. Ranges that may be obtained on V.H.F. are somewhat reduced from those on H.F. since they do not penetrate so well through undulating country or built-up areas. This, however, confers another advantage in that towns separated by comparatively small airline distances need not interfere with each other and consequently the same frequency allocation can be made to several places (e.g., Dunedin, Wellington, Wanganui) without danger of interference. Also V.H.F. is the only practical solution to noise problems associated with large built-up areas where trams, car ignition and electrical interference would preclude the use of any other radio system.

By and large, the present-day V.H.F. radiophone can be considered to be radio manufacturing art and design raised to a very high degree, bearing in mind the service expected from the sets and their reliability under most arduous conditions of service.

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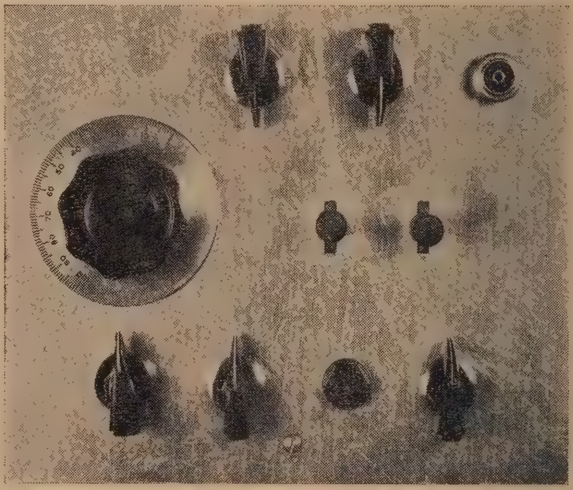
THE RECEIVER (Contd.)

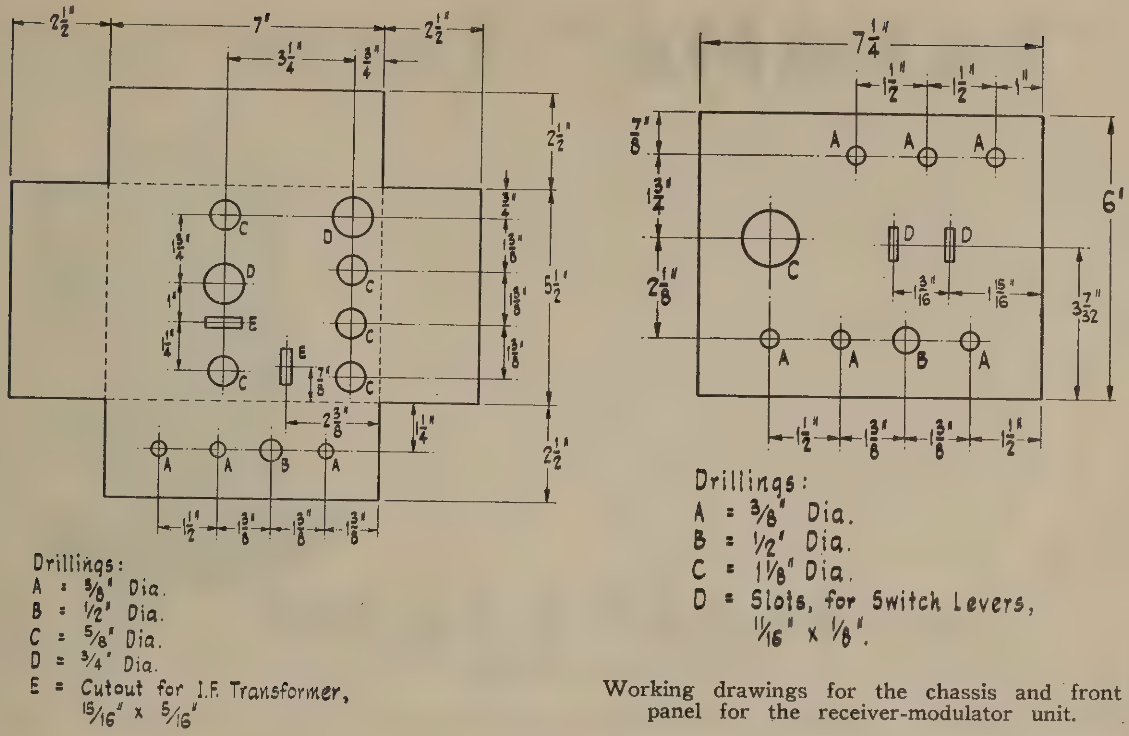
In order to switch in series trimmers for the 40-metre band, it is necessary to have two switch banks in each grid circuit. Taking the grid circuit of the R.F. amplifier as an example, S_{1a} switches the valve grid from the "high" end of one coil to that of the other, while S_{1b} short-circuits the series trimmer, C_8, in the 80-metre position, and removes the short, allowing this condenser to go into circuit, on the 40-metre position. The switching in the mixer and oscillator grid circuits is exactly similar. The device of using common primary windings on all three coils avoids altogether the use of any switching in the aerial circuit, the plate of the R.F. stage, or the plate of the oscillator section of the ECH41.

A point worth mentioning about the circuit detail is the manner in which all cathodes, screens, and plates in the R.F. section of the receiver have been separately decoupled. This uses a few more parts than the often seen expedient of using a common feed to the screens of the R.F. and I.F. amplifiers, but ensures that there can be no undesired feedback due to minute couplings between the screens of the valves. This will not normally occur, of course, even when common dropping resistors and bypass condensers are employed, but it is much the better practice to decouple every valve element separately. On no account, too, should the plate circuit decoupling, R_4 and C_9 in the R.F. stage, R_{10} and C_{19} in the ECH41, and R_{15} and C_{27} in the I.F. stage, be omitted. These filters are usually omitted altogether from ordinary broadcast receivers, and will be found absent even in some communications sets, but it is far far the wisest policy to include them, and be certain the feedback through the H.T. supply cannot cause instability. In constructing the receiver, the cathode and screen bypass condensers should be connected right at their respective socket pins, as should the cathode and screen resistors. Apart from anything else, doing so makes it much easier to find room in the rather restricted space available, for the quite large number of small parts. In general, the plate decoupling resistors, R_4, R_{10}, and R_{15}, do not have ready-made anchorages in the shape of valve socket pins or the like, to which they can be firmly attached. It is therefore essential to provide firm tie-points to which both ends of these and similar resistors can be attached. Nothing is worse, especially in a compact layout, than to have resistors (or condensers, for that matter) "floating" in the wiring, with only the connecting wires as suppports. They are able to shift, and cause changes in stray capacities, with disastrous effects on circuit tracking, or even to come into contact with other portions of the circuit, causing shorts, which can be even more disastrous. The slight additional time taken to fit insulated solder tags, for use as tie-points, in such cases is more than well repaid by the neat and workmanlike job that results, and by stable and lasting results.



Front panel of the receiver, showing all controls for the whole mobile station, apart from the transmitter tuning controls. At the top are the A.F. gain controls for Rx and Tx., and the microphone input socket. In the middle row are the Rx tuning control and the lever-switches for Send/Receiver and Phone/C.W. In the bottom row are (from left to right), the wave-change switch, the manual gain control, the phone jack, and the B.F.O. pitch control.

Another feature of the circuit is the use of relatively small filter condensers in the A.V.C. circuit. We refer to C_3, C_{12}, and C_{20}, whose values are all 0.01 μf., and to C_{34}, which is 0.02 μf. In broadcast and all-wave sets it is usual to make these condensers of the order of 0.05 μf., and many short-wave sets built by amateurs retain this high value. It is not necessarily best to have large condensers in these positions, especially in short-wave receivers. They do not need to be as large as 0.05 μf. purely for bypassing R.F. at these points. Much smaller condensers could be used if that were the only consideration. Their size is more determined by the A.V.C. time-



Working drawings for the chassis and front panel for the receiver-modulator unit.

constant that is desired for the type of receiver concerned. In a broadcast set, a fairly slow-acting A.V.C. is desirable, because fading on this band is quite slow in character, and because the gain of the receiver must not be able to change quickly enough to respond to the amplitude changes represented by low-frequency modulation components. Should it do so, the modulation will be distorted. In a receiver solely intended for voice communication, however, the latter consideration does not apply, since very low frequency modulation components do not (or should not) exist. With this limitation removed, it becomes possible to reduce the time-constant of the A.V.C. circuit, with the result that the control is much faster-acting. It can, therefore, act so as to smooth out what is known as "flutter-fading"—fading which has a fast period, and so remains unaffected by an A.V.C. system with a long time-constant. The ability to handle fast fades is a distinct advantage in a short-wave receiver, especially when there is some possibility that it will have to work under relatively adverse conditions. The same is the case should the receiver be used as the "back end" of a double-conversion receiver for other H.F. or even V.H.F. bands.

The use of a separate double diode for detection and A.V.C. rectification also allowed us to incorporate a reasonably high delay voltage on the A.V.C. diode. This valve has its cathode held at a potential of approximately five volts positive with respect to earth by means of a voltage divider comprising R_{18} and R_{19}. This is not a very high delay voltage, but it is much more than can be obtained when a multi-purpose valve is used. In the latter case, the cathode potential is usually fixed by other considerations, such as the cathode bias required by the triode section, and the maximum delay voltage is usually no more than about 2 volts. The larger delay voltage allows the detector output to be considerably greater, and also gives a much flatter A.V.C. characteristic at high signal input voltages. A higher delay voltage also ensures that the receiver's sensitivity for weak signals is always high—an important point in a receiver which is called upon to work with small signal strengths, in localities where interference is not troublesome.

The output voltage of the beat frequency oscillator is injected into the "low" end of the secondary of the second I.F. transformer, via a small condenser, C_{28}, at the end of a short piece of shielded hook-up wire. C_{28} cannot be specified exactly, as its size will be determined very largely by the amount of coupling between the B.F.O. and the second detector by stray paths. If the B.F.O. wiring is compactly carried out, however, and if it is not allowed to oscillate too hard, there should not be much stray coupling, and quite a reasonably large condenser will be needed for C_{28}. For a first trial, a 25 $\mu\mu$f. condenser can be wired in, in such a way that it can be altered if necessary. The B.F.O. circuit is unconventional, but works quite well. Its main advantage is that it does not require a centre-tapped tuning coil, so that a winding from any discarded 455 kc/sec. I.F. transformer will do for this component. The resistor R_{23} serves both to feed in the H.T. voltage without preventing the circuit from oscillating, and also to reduce the plate voltage on the oscillator, and so control the amplitude of oscillation. Further reference to the adjustment of C_{28} and R_{23} will be made under the heading of "Adjustment," later in this article.

COIL DATA

All coils for the receiver were wound on bakelized paper former, ¾ in. in diameter. Each of the three

(Continued on Page 41.)

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The " RADIO and ELECTRONICS " Abstract Service

AERIALS AND TRANSMISSION LINES

Military and commercial radar systems frequently require that a volume in space be scanned by the radar beam. The paper describes some results obtained in adapting the Schmidt optical system to microwave use. A feed horn pivots about the centre of curvature to illuminate a cylindrical reflector while a special polystrene lens restores the plane wave front.

—*Electronics* (U.S.A.), January, 1953, p. 128.

The mathematical theory of laminated transmission lines. In this paper is contained a general mathematical framework for the analysis of Clogson-type laminated transmission lines with the total thickness of the laminations small compared to the overall dimensions of the line.

—*The Bell System Technical Journal* (U.S.A.), Nov., 1952, p. 1121.

A further article on antennas—dealing with those which owe their sharp directivity and high gain to their reflectors. The reflector gives unidirectional gain, and the theory and manufacture are covered.

—*Radio and Television News* (U.S.A.), January, 1953, p. 36.

A novel approach to microwave transmission and components is described. In place of the more familiar waveguide or coaxial structures a single conductor is supported above a ground plane. Such a configuration is equivalent to a parallel-wire system, for the image of the conductor in the ground plane produces the required symmetry. Losses in this system are approximately equal to those of coaxial structures.

—*Proceedings of the I.R.E.* (U.S.A.), December, 1952, p. 1644.

AUDIO EQUIPMENT AND DESIGN

Phase-shift tone controls—up to the present interest in the effects of phase shift on audio reproduction has largely been confined to the designers of wide-band amplifiers employing large amounts of inverse feedback. The article describes various relationships which may occur due to phase-shift mixing. The effects that can be obtained by appropriate phase delay and subsequent mixing appear to closely resemble the advantages that are claimed for biaural hearing.

—*Radio and Television News* (U.S.A.), January, 1953, p. 56.

A review of distortion and gramophone reproduction—the article gives a classification of distortion and deals with the causes of distortion in gramophone pick-ups and shows the fundamentals necessary for undistorted output at the needle.

—*Electronic Engineering* (Eng.), January, 1953, p. 24.

ELECTRONIC DEVICES

A photo-electric headlight dimmer—the application of the phototube to this purpose makes an appeal to mechanical sensibilities. The tube is shielded to prevent incidental light from affecting it; a threshold control is provided and the amplifier actuates a relay which dips the lamps when met by an opposing beam.

—*Radio and Television News* (U.S.A.), January, 1953, p. 35.

A vibration pick-up amplifier; the instrument has a number of uses—for the watch repairman and for servicing machines where the technician needs to listen to and identify vibration. The basis of the instrument is a simple probe in cartridge form, and the type of amplifier is described.

—*Ibid,* p. 48.

Johnson and Rahbek, over thirty years ago, designed a loudspeaker which made use of the attractive forces between a metal surface and a feebly conducting material when a potential difference is established between them; the device has been much improved. A flexible steel band is held in contact with a revolving cylinder coated with the partially conducting medium, and the modulated p.d. is applied between cylinder and the band. No valve amplification is necessary and the primary source of energy need not be electrical. Incisive speech quality is obtainable.

—*Wireless World* (Eng.), January, 1953, p. 27.

INSTRUMENTS AND TEST GEAR

A low-frequency function generator is described which will produce square, triangular, and sine waves of good quality and constant amplitude in frequency range from 0.01 to 1000 c.p.s. The instrument is useful in the design and testing of servo-mechanisms in developing electronic instrumentation on the geophysical fields and in vibration testing. The instrument eliminates the A.V.C. problems encountered in extending an R.C. oscillator to very low frequencies.

—*Electronics* (U.S.A.), December, 1952, p. 114.

By the use of fast-operating switching circuits, any oscilloscope may be used to display the magnitude of the non-varying component of a signal. Supposing that one should want to know the approximate size of the D.C. component of a signal under observation, if the input terminals of the oscilloscope are momentarily shorted the pattern will give a vertical jump whose magnitude is proportional to the signal's D.C. component. The devices described as specially fast electronic switches that alternatively trace the signal under test, and then short the input terminals. They are activated by the oscilloscope's own sweep circuit.

—*Ibid,* p. 122.

Various methods have been developed for the measurement of minute changes of capacitance changes but this is not easy of achievement. The system described uses a doubly-resonant capacitance bridge and a unique phase-amplitude sensitive discriminator. In the bridge, resonance at a low radio-frequency carrier is induced in two modes. This bridge circuit is excited via a low-impedance transmission line from the crystal controlled oscillator. When unbalance occurs by change in capacitance, the resultant signal current is transmitted via another low-impedance transmission line to the signal amplifier.

—*Ibid,* January, 1953, p. 105.

Measuring characteristics of transmission lines: the method used is based on the fact that if a section of a line a number of half-waves long is resonated when both ends are shorted, the standing wave ratio at the receiving end will be greater than at the input end, and the change is due to the attenuation of the line, so that the attenuation may be determined as a function of the standing wave ratio—the ratio of maximum to minimum current in the line, and the grid-dip meter and microammeter are used for the measurements.

—*Radio and Hobbies* (Aust.), February, 1953, p. 19.

A survey is given of the various service-type oscilloscopes currently available and details of how the instrument is used in radio and television repair operations.

—*Radio and Television News* (U.S.A.), January, 1953, p. 31.

It is useful to be able to measure the impedance of an antenna with the measuring equipment connected directly to the antenna terminals but the equipment may alter the value of the impedance. The instrument is designed to have a small capacitive loading effect when directly connected and operates up to 30 mc/sec.

—*Proceedings of the I.R.E.* (U.S.A.), December, 1952, p. 1686.

There are occasions, such as when teaching, when phase-relationship needs to be shown and two wave-forms have to be shown on the oscilloscope. This can be shown by a switching operation, and the principles are described with the type of switching apparatus needed for the problem.

—*Wireless World* (Eng.), January, 1953, p. 11.

MATHEMATICS

When a pulse or other signal is applied to a filter with limited band-width the output is a distorted version of the input because some of the frequency components are attenuated. A nomograph gives minimum band-width required for adequate transmission of a periodic rectangular pulse, based on spectral distribution for pulse energy, for any selected efficiency of ideal and R.C. filters.

—*Electronics* (U.S.A.), December, 1952, p. 142.

Chart for the TE11 Mode piston attenuator; a nomograph finds the attenuation constant for cylindrical waveguide operated in this mode below cut-off. It may be used to design piston attenuator with minimum frequency dependence over a given range.

Ibid, January, 1953, p. 142.

However simple a book on electronics may be, it is bound to include resonance. This article opens the subject again for the student in the clear manner for which these articles are justly famous, and the explanation will be of greatest assistance to many.

—*Wireless World* (Eng.), January, 1953, p. 29.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

Printed, etched windings for power transformers: a British firm has for many years been working on a novel system of printed circuitry by which the pattern required is printed with special ink on to a metallized film applied to an insulating base. The winding is then folded into what appears a booklet form, and compressed to give the complete electrical path.

—*Radio and Hobbies* (Aust.), February, 1953, p. 17.

PROPAGATION

The future of sound broadcasting is studied: the question of how far television is ousting sound broadcasting is a matter of great importance, and the general feeling is that where the television set exists, the sound broadcast has but a poor hearing; the conclusion is reached, however, that the B.B.C. has no real basis for reducing its broadcasting in favour of television.

—*Wireless World* (Eng.), January, 1953, p. 17.

RECEIVERS

If the amateur goes the right way about it, he can still build a better receiver than the manufacturers make, for commercial designs are a series of compromises. The design given is for a modern four-tube superhet (with 8-tube performance) that

(Continued on Page 48.)

Tube Data: The EC81, U.H.F. Oscillator Triode

The EC81 is an indirectly-heated triode designed for oscillator service at ultra high frequencies, the maximum frequency being about 1500 mc/sec. ($\lambda = 20$ cm.). At 750 mc/sec. ($\lambda = 40$ cm.), an output of 1.3 watts can be obtained; at 500 mc/sec. ($\lambda = 60$ cm.) 3 watts and at 300 mc/sec. ($\lambda = 1$ m.) 3.8 watts. If higher output power is required two tubes can be connected in push-pull. The mutual conductance of the EC81 is high ($S = 5.5$ mA/V); the amplification factor is 16.

The EC81 is an excellent oscillator for a great number of applications such as a transmitter, local oscillator in receivers for Citizens or Business radio, a beam transmitter in radio links, in balloon sondes and measuring equipment, etc.

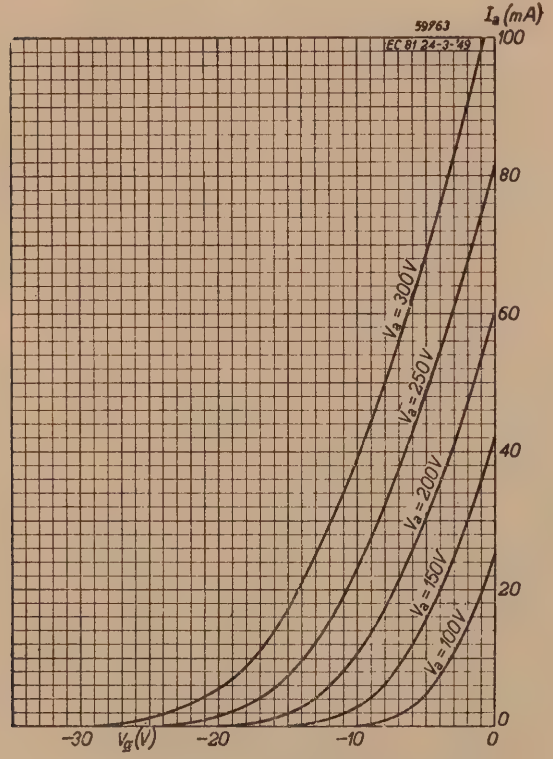
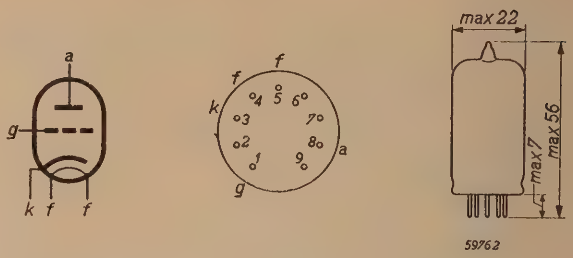


Plate and grid current characteristics.

The generation of ultra high frequencies with the EC81 has become possible by taking the measures described in the introduction. Moreover, the capacitances between the various electrodes have been made very small, thanks to the exceedingly small dimensions of the electrode system. This has been achieved by shaping the anode in a special way so as to combine small capacitances with a high heat dissipation.

The operating characteristics of the EC81 are given below, under various conditions with reference to the constancy of the supply voltage.

In the first place the data and maximum values under normal operating conditions are given,



Physical dimensions and socket connections.

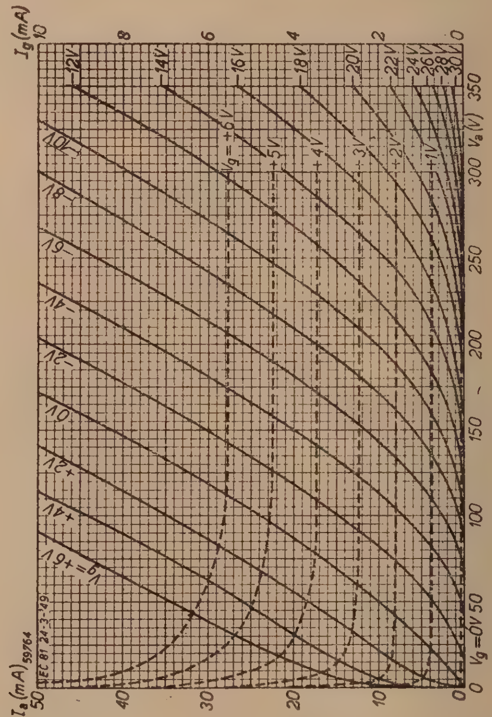


Plate current/grid voltage curves for a range of plate voltages.

In this case the maximum admissible anode dissipation is 3.5 watts; the heater can be fed from a 6.3 volts supply source if a resistor of 3 ohms is connected in series. At a frequency of 750 mc/sec. an output of 0.7 watts can be obtained.

In the second place operating data and maximum values are given under absolute maximum conditions. The maximum admissible value of the anode dissipation is then 5 watts, the anode voltage 300 volts, and the cathode current 30 mA. It must be stressed that these values should never be exceeded under any usual condition of supply voltage variation, load variation, or manufacturing tolerances in the equipment itself.

When the tube is operated with the maximum cathode current of 30 mA it will be necessary to feed the heater from a supply source of 6.3 volts the fluctuations of which do not exceed ± 3 per cent.

The obtainable output at 750 mc/sec. is 1.3 watts in this case.

BASE AND SOCKET

The EC81 is provided with a standard noval base. Owing to the very high frequencies at which the tube can be used the material of the socket must answer high requirements. The Philips socket type 5908/03 is recommended. In order to diminish as far as possible the capacitances between the various electrode leads, it is recommended to remove the unused contacts of the socket. At the highest frequencies the tube must be used without socket.

The small dimensions and the normal operating voltages make the EC81 especially suitable for use in fixed and mobile equipment. The tube can be mounted in all positions; if, however, shocks have to be expected, or if the tube is not used in an upright position, it is recommended that the tube be supported.

In order to obtain sufficient cooling, the tube must be installed in such a way that air can circulate freely around it. This is of special importance if the tube is used with its maximum admissible anode dissipation.

TECHNICAL DATA

Heater Data

Heating: indirect with A.C. or D.C.; parallel supply

Heater voltage .... $V_f = 6.3$V[1]

Heater current .... $I_f = 0.2$A

Capacitances (measured with tube cold)

Input capacitance	C_g	= 1.7 pF
Output capacitance	C_a	= 0.5 pF
Capacitance between grid and anode	C_{ag}	= 1.5 pF
Capacitance between grid and heater	C_{gf}	< 0.2 pF
Capacitance between cathode and heater	C_{kf}	= 2.3 pF

Typical Characteristics

Anode voltage	V_a	=	120	150 V
Grid voltage	V_g	=	−2	−2 V
Anode current	I_a	=	20	30 mA
Mutual conductance	S	=	4.0	5.5 mAV
Amplification factor	μ	=	16	16

Operating Characteristics as an Oscillator

A. Normal Operating Conditions—

Limiting values (design-centre maxima)

Anode voltage	V_a	=	max. 275 V	
Anode dissipation	W_a	=	max. 3.5 W	
Cathode current	I_k	=	max. 20 mA	
Heater supply voltage	V_{bf}	=	6.3 V	
Heater series resistor	R_f	=	3 Ω	
Frequency	V_a	=	750	375 mc/sec.
Anode voltage	f	=	230	275 V
Anode current	I_a	=	18.2	17.0 mA
Grid current	I_g	=	1.8	3.0 mA
Input power	W_{ia}	=	4.2	4.7 W
Output power	W_o	=	0.7	1.8 W

B. As under A but Anode Voltage Stabilized

Limiting values

Anode voltage } (absolute maxima)	V_a	=	max. 300 V	
Anode dissipation } (absolute maxima)	W_a	=	max. 5 W	
Cathode current (design-centre maximum)	I_k	=	max. 20 mA	
Heater supply voltage	V_{bf}	=	6.3 V	
Heater series resistor	R_f	=	3 Ω	
Frequency	f	=	750	375 mc/sec.
Anode voltage	V_a	=	300	300 V
Anode current	I_a	=	18.4	17.0 mA
Grid current	I_g	=	1.6	3.0 mA
Input power	W_{ia}	=	5.5	5.1 W
Output power	W_o	=	1.0	2.0 W

C. Under maximum Operating Conditions—

Limiting values (absolute maxima)

Anode voltage	V_a	=	max. 300 V	
Anode dissipation	W_a	=	max. 5 W	
Cathode current	I_k	=	max. 30 mA[1]	
Heater voltage	V_f	=	6.3[1] V	
Frequency	f	=	750	375 mc/sec.
Anode voltage	V_a	=	230	300 V
Anode current	I_a	=	27.7	26.1 mA
Grid current	I_g	=	2.3	3.9 mA

---

[1] When using a heater voltage of 6.3 volts, the fluctuations of this voltage must not exceed ± 3 per cent. In this case the absolute maximum of the cathode current amounts to 30 mA. When the heater voltage fluctuations exceed 3 per cent., a resistor of 3 ohms must be connected in series with the heater. In this case the maximum admissible cathode current is 20 mA.

Input power	W_{ia}	=	6.3	7.9 W
Output power	W_o	=	1.3	3.5 W

Limiting Values

Absolute maxima				
Anode voltage	V_a	=	max.	300 V
Anode dissipation	W_a	=	max.	5 W
Cathode current	I_k	=	max.	30 mA[1]
Design-centre maxima				
Anode voltage in cold state	V_{ao}	=	max.	550 V
Anode voltage	V_a	=	max.	275 V
Anode dissipation	W_a	=	max.	3.5 W
Grid bias	$-V_g$	=	max.	100 V
Grid current start	$V_g(I_g = +0.3\,\mu A)$	=	max.	—1.3 V
Cathode current	I_k	=	max.	20 mA
Grid current	I_g	=	max.	7.5 mA
External resistance between grid and cathode	R_g	=	max.	1 MΩ
External resistance between cathode and heater	R_{fk}	=	max.	20 kΩ
Voltage between cathode and heater	V_{fk}	=	max.	100 V

Missing and Stolen Radios

Criminal Investigation Branch, Auckland

Pacemaker portable, serial No. 97931.

Mullard 6-valve portable, model 681, serial No. 26006.

Skyscraper, 4-valve A.C. broadcast mantel model, walnut veneer cabinet 15 in. x 10 in. x 9 in., dial 6 in. x 4 in. in front, band tuning, adapter and lead for extension speaker fitted to chassis at back.

Empire 6-valve battery mantel model, serial No. S.6758. Oak cabinet 18 in. x 9 in. x 12 in.

Antone 5-valve battery and A.C. portable, serial No. 793. Wine coloured plastic case. Radio requires repairs.

Emmerson radio (American) with transformer for A.C. at back. Brown bakelite cabinet 12 in. x 5 in. x 5 in., dial in front below speaker. White paint spots on top of cabinet. Aerial wound on cardboard and attached to back with transformer. Two wave-bands—broadcast and American police stations.

Ultimate A.C. battery portable, serial No. 129458. Brown bakelite cabinet 10 in. x 6 in. x 9 in. with plastic carrying handle.

Philips all-wave 1946 6-valve mantel model, serial No. 30667. Wooden veneer cabinet 2 ft. x 12 in. x 18in. 18 in. x 4 in. dial on top front of case, 8 in. speaker covered with torn fawn fabric. Magic eye. Slide dial. Four tuning knobs, but three missing. Radio needs repairs.

Queens Street Wharf, Auckland

H.M.V. Australian 4-valve, dual-wave, mantel model, reddish brown plastic case 15 in. x 12 in. x 9 in. square dial with Australian stations and four New Zealand YA stations. Two-volt battery supply with built-in vibrator. Tuning knob and screw socket on back chipped. Trade mark mounted on white plastic oval mould with dog and gramophone in raised relief.

Police Station, Newmarket

Sheffield Countess mantel model, serial No. 10135. 12 in. x 9 in. cream and fawn bakelite case, three control buttons.

Criminal Investigation Branch, Hamilton

H.M.V. "Nipper", serial No. 24985. Colour, brown.

Police Station, Mount Maunganui

Model 39, 12-volt 6-valve auto radio, serio No. 399805, also chrome telescopic car aerial.

Police Station, Wanganui

Autocrat 6-volt A.C. 6-valve car radio, serial No. 8270. Grey and brown metal case, with two white plastic knobs on front. Separate loudspeaker.

Mount Cook Police Station, Wellington

Pacemaker 5-valve portable, serial No. 97932.

Criminal Investigation Branch, Wellington

Philco A.C./battery portable, model 353P, set No. W.15511, serial No. 29968. Wooden cabinet covered with brown mottled leatherette; brown leather carrying handle. Cover over dial similar to venetian blind. Three control knobs.

Mullard 5-valve broadcast A.C. and battery portable, model 618, serial No. 3303. Dark redwood case covered with imitation leather, fitted with 15 in. brown covered flex and a three-pin plug.

Criminal Investigation Branch, Palmerston North

Pacemaker 5-valve radio, serial No. 35885, wooden cabinet, stolen from ordnance stock Linton Military Camp within the last two years.

Police Station, Palmerston North

Philips 6-valve A.C. and battery radio, serial No. 1873. Red plastic embossed covering, with yellow bakelite grille and fittings. Has carrying handle.

Criminal Investigation Branch, Christchurch

Andrea portable, dark brown crocodile case 16 in. x 12 in. x 12 in. Dual wave, 3 knobs, round dial. Separate metal transformer.

Police Station, Dunedin

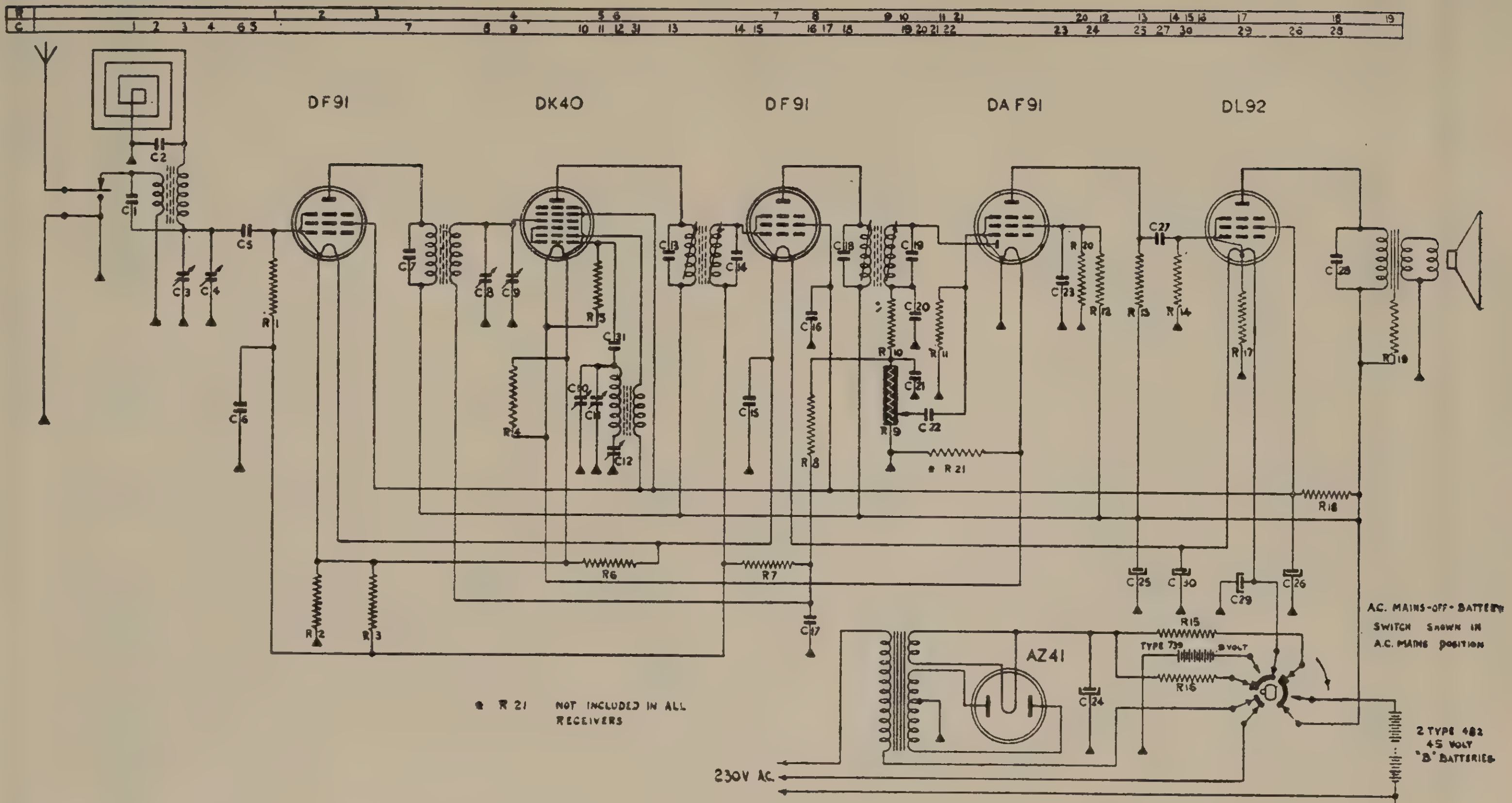
Philips 5-valve broadcast and short-wave radio, model 327, royalty No. 58889, serial No. 33917. 15 in. x 12 in. x 6 in. Brown bakelite case.

Criminal Investigation Branch, Invercargill

Autocrat 12-volt car radio, serial No. U 1020. Colour brown, volume and tuning knob.

Cromwell 5-valve broadcast serial No. 74898. Cream plastic case 9 in. x 6 in. gold coloured metal facings. Retractable handle on top.

FOR THE SERVICEMAN—Philips Radioplayer Model 545



C1	3.9 mmfd. ceramic
C2	25 mmfd. mica
C3	3-30 mmfd. trimmer
C4	Tuning condenser
C5	100 mmfd. ceramic
C6	0.01 mfd. 400v. paper
C7	25 mmfd. ceramic
C8	3-30 mmfd. trimmer
C9	Tuning condenser
C10	3-30 mmfd. trimmer
C11	Tuning condenser
C12	400-750 mmfd. padder
C13	100 mmfd. mica
C14	100 mmfd. mica
C15	0.1 mfd. 200v. paper
C16	0.1 mfd. 200v. paper
C17	0.01 mfd. 400v. paper
C18	100 mmfd. mica
C19	100 mmfd. mica
C20	100 mmfd. mica
C21	100 mmfd. mica
C22	0.005 mfd. 400v. paper
C23	0.1 mfd. 200v.
C25	40 mfd. 400v.
C24	40 mfd. 400v. triple
C26	20 mfd. 400v. electro
C27	0.005 mfd. 400v paper
C28	0.005 mfd. 400v paper
C29	500 mfd. 12v. electro.
C30	25 mfd. 25v. electro.
C31	100 mmfd. mica
R1	.5 meg. ¼ watt
R2	300 ohm ½ watt
R3	4.7 meg. ¼ watt
R4	680 ohm, ½ watt
R5	30,000 ohm, ½ watt
R6	330 ohm, ½ watt
R7	4.7 meg. ¼ watt
R8	2.2 meg. ½ watt
R9	.5 meg. vol. control
R10	68,000 ohm, ¼ watt
R11	10 meg ¼ watt
R12	3 meg ½ watt
R13	1 meg ¼ watt
R14	2.2 meg. ¼ watt.
R15	2200 ohm, 3 watt
R16	2600 ohm 10 watt
R17	2200 ohm ¼ watt
R18	2700 ohm ½ watt
R19	1 meg. ¼ watt
R20	1 meg. ¼ watt
R21	390 ohm ½ watt

Some Things Are Worth Thinking About

For instance, when you are planning a D.C. source of power, valve rectifiers are often the only ones you give a thought to, but it is a fact that they are not always the best type to use, by a long way. If you haven't considered selenium rectifiers for your power supply requirements, then these are certainly worth thinking about. We would not pretend that selenium rectifiers are better suited than valves to any rectifying job, but there are some facts you should know about them, nevertheless. For example

THEY LAST MUCH LONGER.

Used within their ratings, the life of selenium rectifiers is virtually unlimited. This is one fact you can't afford to ignore for medium or high-powered supplies—cases where valves are expensive, both in first cost and for replacement purposes. Then again—

THEY OPERATE INSTANTANEOUSLY.

There is no filament to heat up. The instant A.C. is applied, D.C. is available at the output terminals. Compare this with the careful switching-on procedure needed with all valve rectifiers except the smallest.

THEY ARE ROBUST.

In applications where the equipment is subject to vibration or mechanical shock, the solid construction of selenium rectifiers makes them much more suitable than relatively fragile valves.

THEY CAN BE USED FOR ANY CURRENT OR VOLTAGE.

We stock discs capable of delivering currents from 100 ma. to as much as 200 ampers per disc, and these can be made into stacks suitable for any voltage or current and any rectifier circuit, from single-phase half-wave to voltage multiplying circuits or high-powered three-phase bridge circuits.

These are only a few of the advantages of selenium rectifiers. To tell their full story would take a book, and we certainly haven't room for that here. What we can do, though, is to offer our expert advice on selenium rectifying systems to anyone who has a rectifying problem.

We hold stocks of rectifier discs in all sizes, and can supply immediately any rectifier to your exact specifications.

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The "R. & E." Synch. Signal Generator—Part III

By W. D. FOSTER

Part II of this series, featured in last month's issue, described the master oscillator, operating at twice the frequency of the lines, and the frequency dividing circuit which is used to derive from the M.O. a waveform having half the original frequency. In this instalment, we proceed to describe the pulse generator which produces the line blanking pulses, of approximately 16 μsec. duration.

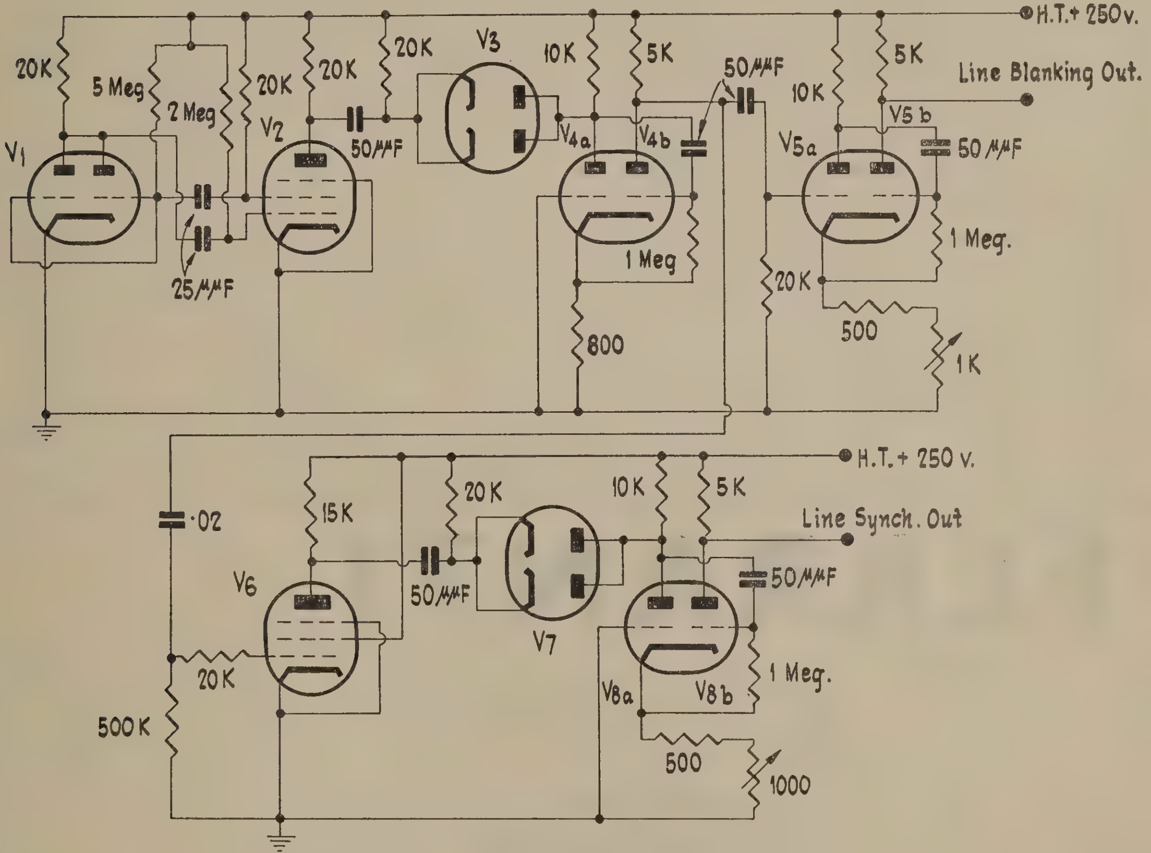

Fig. 2.—Circuits referred to by the block diagram of Fig. 1.

GENERATING THE LINE BLANKING PULSE

The valves V_3 and V_4 in the circuit diagram produce a rectangular wave at a frequency of exactly half the master oscillator frequency, and therefore of the frequency required for the line synchronizing pulses and the line blanking pulses. As a result, these two trains of pulses are made from the output of V_{4b} without any further frequency division. Fig. 3 (c) shows the waveform to be found at the plate of V_{4b}, and its time relationship with the original square-wave of the master oscillator. To recapitulate briefly, the negative-going voltage jump at the plate of V_2 is made to provide a brief negative-going pulse. Every other one of these pulses, which are shown in Fig. 3 (b), is made to trigger off the flip-flop circuit of V_4, so that the latter's cycle takes place only once for every two cycles of the master oscillator. As Fig. 3 shows, a positive-going voltage jump occurs at the plate of V_{4b} at exactly the same moment as the synchronizing pulse, and therefore at the same instant as the negative-going jumps at the plate of V_2. This point is emphasized because the timing of the whole synchronizing unit is "tied" to this negative jump at the plate of V_2. In the finished synch. signal, this instant will correspond with the beginning of a line of the picture, and every timing operation in the whole circuit can be traced back to it. In Fig. 3 at (d) we have shown the output of V_{5b}, coinciding in time with the positive jump at the plate of V_{4b}, and also with the negative jump at the plate of V_2. However, to make quite clear just how the output of V_{5b} comes to be so timed, Fig. 4 has been drawn, starting at the plate of V_{4b}. Waveform (a) in Fig. 4 is the same one as (c) in Fig. 3. Waveform (b) is the triggering waveform, which in the case of V_5, is fed to the control grid of V_{5a} instead of that of V_{5b}. Since this is the case, the triggering pulse will need to be a positive one.

By this time, readers will probably have recognized that the circuit of V_5 is almost identical with that of V_4, the only difference being the addition of a variable portion to the cathode resistor. The circuit, like that of V_4, is a cathode-coupled flip-flop, and is to be triggered by a pulse before it departs from its stable state, which, again like V_4, is with V_{5a} normally cut off, and V_{5b} normally conducting. A glance at waveform (d) in Fig. 3, or waveform (c) in Fig. 4, will show that the output of V_5 is exactly similar in kind to the output of V_4. Only one difference is apparent, and that is in the time-duration of the unstable states. In V_4, the unstable state (i.e., after triggering) lasts until just before the next-but-one triggering pulse arrives, so that the action is that of frequency division, but in V_5, the unstable state lasts only for a very short time—in practice, for the 16 μsec. duration that we need for the blanking pulse. Apart from this, there are no essential differences between the two circuits. The cathode resistor has been made variable so that we will have a simple method of adjusting the exact duration of the pulse put out by the plate of V_{5b}.

In case it may not yet be quite clear to everyone just why V_5 is triggered on the grid of V_{5a}, instead of through a diode, as for V_4, it should be pointed out that we want V_5 to trigger at the same time as the positive jump in the plate circuit waveform of V_{4b}. Now we follow V_{4b} by a short time-constant CR circuit, again consisting of a 50 $\mu\mu$f. condenser and a 20k. resistor, but this time with the resistor connected to earth instead of to H.T.+. This produces exactly the same sort of effect as the previous short CR circuit ahead of V_4, giving a positive triangular pulse for each positive-going jump at the plate of V_{4b}, and a negative pulse, similar in shape, for every negative-going jump. The positive ones are those which we must use for triggering V_5 if the beginning of its pulse is to coincide with the positive jump of the V_{4b} output waveform. In other words, we have positive triggering pulses which must be used, willy-nilly, and for this reason they must be injected into a portion of the V_5 circuit that is sensitive to positive-going pulses. The grid of V_{5b} is sensitive only to negative-going pulses, since this section of the valve is heavily conducting, and a positive pulse would have no effect. V_{5a}, on the other hand, is normally cut off, so that a positive pulse injected into its grid will cause it to start conducting, and will thus trigger the whole circuit off. There is no need to describe the action of V_5 in detail, as was done for V_4, because the two are identical. In practice, all we have to do is to adjust the cathode resistor until the output pulse at the plate of V_{5b} has the required duration, approximately 16 microseconds.

ADJUSTING THE CIRCUIT SO FAR DESCRIBED

In dealing with circuits of this kind, it is imperative to have an oscilloscope, in order to adjust the operating conditions correctly. The method is simply

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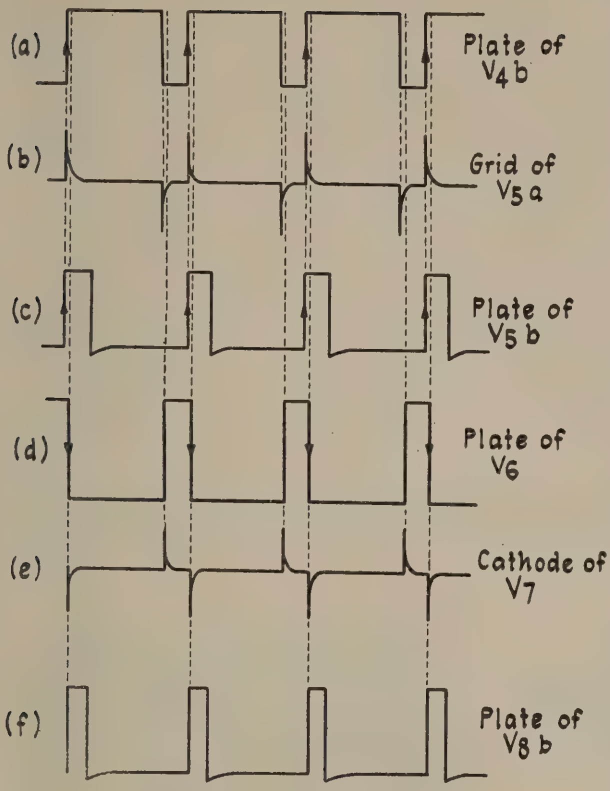

Fig. 4

to display the waveforms at each important point on the whole circuit off. There is no need to describe of the oscilloscope, and locking the time-base to the master oscillator, so that a stationary picture is obtained. The best way of locking the time-base is to attach a 5 μμf. mica condenser to the plate of V_2, and then take a lead from the free end of the condenser to the synch. terminal of the 'scope. It is best for a start to work without an amplifier, applying the waveforms directly to one Y plate of the cathode ray tube, with the other Y plate grounded. The signal voltages are large, and will give a suitably-sized deflection on most 'scopes without recourse to amplification, and besides, unless the 'scope amplifier has a flat response out to at least 200 kc/sec., it will not show the true conditions or the actual waveforms in the circuit, since it will distort them. Applying them directly to the Y plate, as suggested will ensure that the picture obtained is a true one, undistorted by poor frequency response. First of all, then, the output of V_2 is used to lock the 'scope's time base, and the Y plate can be connected to the plate of V_2 also, but through a large blocking condenser of, say, 0.05 μf. This done, the controls of the time-base are adjusted until a stationary picture is obtained, showing several cycles of the master oscillator's output. When this is done, you will probably get a rude shock at first, because the waveform will not look very much like Fig. 3 (a). However, in practice there will be only two differences, neither of which will affect the opera-

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tion, and which are quite normal. First, it will be noticed that the positive half-cycles are considerably shorter in duration than the negative ones. This is simply because Fig. 3 was drawn on the assumption that the two grid leak resistors would be approximately equal, making the half-cycles of equal duration. The second thing to note is that the positive voltage jump is quite slow compared with the negative one, thus illustrating why the negative one was chosen as the one from which succeeding operations should be triggered. At this stage, it is worth while to ensure that the picture is the right way up on the screen. If the wrong Y plate was earthed, an upward deflection will represent a negative voltage change, and the picture will be upside down. To test whether an upward deflection indicates a positive voltage on the deflecting plate, it is only necessary to touch the blocking condenser on the end of the test lead to earth, in order to discharge it, and then touch it on to the H.T. line. If the spot jumps upwards before returning to the centre of the tube, the polarity is correct, but if the initial jump of the spot is downwards, the connection of the Y plates should be reversed.

There is another possibility for confusion when viewing waveforms like these, and that is if the time-base is running the wrong way. In the waveforms, as printed here, time, which is the X axis, is depicted as going from left to right. This means that the forward stroke of the time-base must travel from left to right, and the flyback, from right to left. There is a simple way of testing this, too. The time-base is run unsynchronized, and the fine frequency control is adjusted until the waveform is as nearly stationary as possible. Then, a slight difference is made to the frequency of the oscillator by temporarily touching a 10 meg. resistor across one of the grid leaks of the oscillator. This will increase the frequency of the oscillation, so that if the time-base is running in the right direction, the waveform will move from right to left. Alternatively, if it is known that turning the fine frequency control of the time-base in one direction increases the frequency, a slight movement in this direction will cause a stationary picture to drift

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to the right, if the time-base is correctly connected. If it does not, the connections to the X plates should be reversed.

With these tests completed, we can be sure that the picture is the right way up and the right way round to suit the conventions that we have become used to. Having locked the time-base so that at least three, and preferably four cycles of the master oscillator are shown on the screen, we are now in a position to set up the rest of the circuit. With the circuit constants illustrated in the diagram, the frequency divider, V_4, should not require any adjustment, and a quick check with the 'scope will confirm or confound this view. The triggering waveform can be monitored by attaching the Y plate lead to the cathode of V_3, when the waveform of Fig. 3 (b) should be seen. If the oscillator is functioning, and the correct waveform is not seen at the cathode of V_3, this can only mean that either the 50 $\mu\mu$f. condenser or the 20k. resistor following it is defective. Next, have a look at the plate of V_{4b}. If all is well, a waveform resembling that of Fig. 3 (c) or Fig. 4 (a) should be seen. About the only thing that can be wrong with it is that the long positive portion may not be of the right length. If it is too short, and comes before the negative triggering pulse that is supposed to be inactive, the circuit will not frequency divide, but will produce one cycle for each cycle of the master oscillator. Ideally, the negative recovery step should occur approximately at the same time as the unused positive pip in Fig. 3 (b), or as nearly as possible half-way between the triggering pulse and the preceding negative pulse which does not trigger the flip-flop. Where it actually comes will depend mainly on the exact values of the 50 $\mu\mu$f. coupling condenser, from the plate of V_{4a} to the grid of V_{4b}, and the 1 meg. grid leak of V_{4b}. It should be understood that in the prototype equipment, ordinary 20 per cent. tolerance components were used, so that even if the nominal values are strictly adhered to, there is a possibility of things not working exactly according to the book. For example, should both these parts be near the maximum values allowed by the tolerances, the time-constant could be 40 per cent. out, but this should not normally prevent proper operation. If it should be found that the circuit of V_4 is being triggered satisfactorily, but is working on every negative input pulse, the cure will be to increase either the condenser or the resistor, or both. For other reasons, it is best to adjust the value of the resistor. Should the recovery be taking place inconveniently close to the triggered positive jump, there will be a possibility that drift of circuit values might at some later stage result in the circuit's dividing by three rather than by two. Hence the recommendation that the recovery should take place half-way between the practical limits for one-to-one triggering, on the one hand, and dividing by three, on the other.

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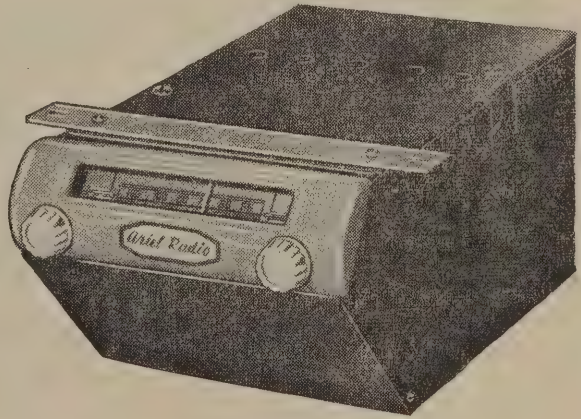

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When V_4 has been set up, the waveform at the grid of V_{5a} can be examined, and will be found to resemble that of Fig. 4 (b). Next, V_5 is plugged in, and the 'scope transferred to the plate of V_{5b}. This time, it is extremely unlikely that the correct waveform will be visible on first switching on. This is merely because the cathode resistor, being made variable, gives a very wide range of adjustment. However, watching the waveform on the 'scope and adjusting the cathode resistor will enable a waveform like Fig. 3 (d) or Fig. 4 (c) to be obtained. If the unit were being set up for actual television use, as it will be when finished, there would be some point in accurately adjusting the length of the positive pulse at the V_{5b} plate to the official value of 16.4 microseconds. However, initially, it will be well enough if we do this approximately, by noting that the complete cycle at line frequency lasts for 98.7 μsec., while the blanking pulse should last for 16.5 μsec. The remainder of the cycle therefore lasts for 72.2 μsec. An approximate adjustment of the pulse length can therefore be made by adjusting the length of one cycle on the C.R.T. screen to be any convenient figure, after which the cathode control is adjusted to make the positive pulse 16.5/98.7 or 0.169 of the total period.

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TV News of the World

European International Television Relay

The B.B.C. has invited television representatives from France, Holland, West Germany, Belgium, Italy, Switzerland, and Denmark to London to discuss their requirements and facilities for "live relays or telefilming" of Coronation television scenes this year.

The French television authorities are expected to rebroadcast the B.B.C. television from Lille using a 405/819 lines converter.

Theatre Television Frequency Proposals—U.S.A.

The theatre television interests in America are having hearings with the F.C.C. on frequency allocations for exclusive use for theatre television transmissions.

The theatre television engineering proposals as outlined by the various engineers are as follows:

1. The F.C.C. should set aside six 60 mc/sec. circuits for the nation-wide theatre television service, each circuit containing two 30 mc/sec. channels, using a 10 mc/sec. video bandwidth. This system would make possible six competitive theatre television services, including both inter-city relays and intra-city distribution to theatres.
2. They request the exclusive allocation of the 5925–6285 mc/sec. band, first choice or 6425–6575 mc/sec. band as their second choice.
3. They want the theatre television picture that looks as good as 35 mm. film, which in their opinion requires a 10 mc/sec. bandwidth with a 735-line picture.

New Patent on Colour Television Picture Tube

The R.C.A. has received a new patent which is for an improved picture tube using a single electron gun instead of the customary three, for red, green, and blue respectively.

Printed Circuits in Television Receivers

The President of the Hallicrafters Co. in New York recently predicted that printed circuits would be in use for television receivers in approximately two years and that by using this process a price reduction up to 25 per cent. is possible.

Picture Tube Sales 9 Months 1952—U.S.A.

The picture tube sales for the nine months of 1952 totalled 3,120,332 valued at 69,664,135 dollars as against 3,146,173 valued at 78,852,954 dollars for the same period in 1951.

The September 1952 sales for the industry was 640,793 picture tubes valued at 14,326,017 dollars.

Rectangular 16-inch and larger represented 99.26 per cent. of the September total.

Television Saturation—U.S.A.

Dr. W. R. G. Baker of General Electric predicts that the number of television sets in operation in the U.S.A. may exceed the number of homes with electricity by 1960.

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General Electric market research indicates that 53,000,000 sets will be in operation by 1960, more than three times the present number and five million more than the number of homes expected to have electricity by that time. Between seven and ten million homes will have two television sets.

F.C.C. Grants of Television Station Constructions—U.S.A.

The F.C.C. has granted construction permits, totalling 108 since the lifting of the "freeze."

The breakdown of the 108 permits shows that 99 construction permits were for commercial stations 28 V.H.F. and 71 U.H.F., and that nine permits were for educational stations, 2 V.H.F. and 7 U.H.F.

There are now 112 television stations on the air in the U.S.A.

Television Picture Tube Developments

Over the last few months the following announcements have been made:

1. Sylvania: Production of a 24-inch rectangular picture tube will commence in May, 1953.
2. National Union: A 24-inch glass rectangular tube will be available early this year using the "K-Band" metal edge around the face plate.
3. Pioneer Electronics Corp.: Report that a 27-inch glass rectangular picture tube is now in production.
4. General Electric: Announced the development of a 27-inch glass rectangular picture tube, magnetic focus, and aluminium backing—picture size 24 in. x 18½ in.
5. Hytron: Have announced a new 27-inch glass rectangular picture tube, 90 degrees, spherical face plate and alumized screen.
6. Corning Glass Works: Are producing samples of a 27-inch glass rectangular picture tube, with volume production expected next May. The new bulb the largest piece of moulded glass manufactured in the world on automatic production equipment and offers a 375 square inch picture which is 50 per cent. greater than that obtained with the 21-inch tube.

Life of Television Sets—Estimates

It has been estimated in the U.S.A. that the life span of a television receiver is around 8½ years, for television picture tubes 5½ years. The generally accepted span of life of radio sets in the U.S.A. is 7 years, automobiles 13½ years, and 12-13 years for refrigerators.

It is estimated that the eventual replacement television set market will be 12 per cent. per year and for picture tubes 18 per cent. per year.

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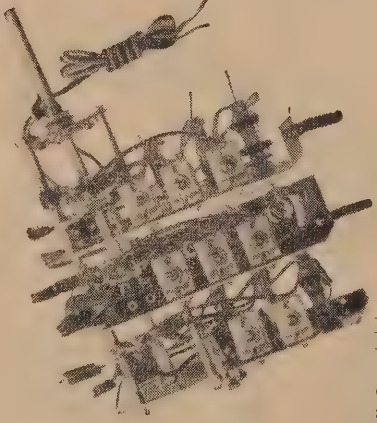

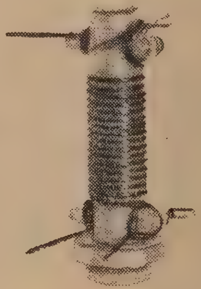

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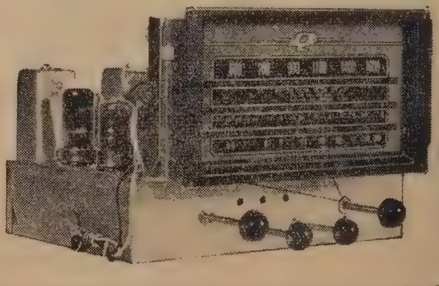

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Philips Experimenter

(Continued from Page 24.)

formers is 2¼ in. long, which allows plenty of spare room at each end, so that when two of the formers are mounted vertically under the chassis, the ends of the coils do not approach the chassis too closely. The windings are terminated by reeving the wire several times through small holes bored in the former. When this has been done, it is possible to scrape off some of the enamel insulation from the portions passed round and round through the holes, and make a satisfactory tie-point with a blob of solder. Those ends of the coils which have to go to the wave-change switch are left long enough to go directly to the switch contacts, but with fine spaghetti placed over the not-very-thick wire for protective purposes. Winding data for the coils are as follows:—

Winding	Wire	Turns
L_{1a}	36 en.	10
L_{1b}	28 en.	40
L_{1c}	28 en.	17
L_{2a}	40 en.	20
L_{2b}	28 en.	40
L_{2c}	28 en.	17
L_{3a}	36 en.	10
L_{3b}	28 en.	33.5
L_{3c}	28 en.	15.5

The 80-metre tuning coils (b in each case) are started ⅝ in. from one end of the former, and a gap of ¼ in. is left before putting on the 40-metre coils, c. In these gaps are wound the primaries, and it will be noticed that much finer wire has been specified for these windings than for the tuned windings. The purpose of this is to make the primaries very compact—only about ⅛ in. long—so that their position can be adjusted between the two tuned windings, so as to give the best results on both bands. This is more important in the case of the oscillator coil, where the position of the tickler has to be adjusted so that the one tickler winding functions satisfactorily for both oscillator tuning coils. In achieving this, the only adjustment is to move the tickler farther from one secondary and nearer to the other.

PHYSICAL CONSTRUCTION

The whole receiver and modulator unit is built on a chassis only 5½ in. x 7 in. x 2½ in. deep. The diagrams and photographs give a good idea of the layout used in the original, which is of the same size as the chassis used for the transmitter. It is thus possible to mount the receiver and transmitter either side by side, or one above the other, according to taste, making the whole thing either 14 in. x 5½ in. and 6 in. tall, or 7 in. x 5½ in. and 12 in. tall. Which method of mounting is used does not matter as far as the equipment itself is concerned, and the one can be chosen which best suits the space in which the station is to be fitted.

(To be continued.)

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.005	1000v.	1/–
.01	1000v.	1/2

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Proceedings of the New Zealand Electronics Institute Incorporated.

WELLINGTON BRANCH TELEVISION PROJECT

The Television Committee of the Wellington Branch reports that arrangements are well in hand for commencing the construction of the TV station. It is expected that the work will have commenced by the time these notes are in print.

Up to date, the TV Committee has been fully occupied with planning and design work, and this has been advanced to the stage where it has been possible to draw up lists of the components parts needed for a substantial portion of the complete TV station. Members of the Committee have already approached radio firms in Wellington, requesting donations of parts, and the response has been particularly gratifying. Those firms which have been approached to date have all displayed the greatest interest in the project, and their offers of assistance have been most generous. The Committee wishes publicly to thank the firms concerned for their help, which has been so freely given as to enable an early start to be made. Equipment donated up to the time of writing is as follows:

Messrs. Standard Telephones and Cables Pty. Ltd., two picture tubes, one 14 in. rectangular, and one 12 in. round.

C. & A. Odlin Timber and Hardware Co., Ltd., 24 valves, types EF91 and EQ80.

Messrs Philips Electrical Industries of New Zealand Ltd., 24 valves, types ECC91 and EB91, Ferroxcube cores for winding deflection yokes, transformers, etc., Philips trimmers, and valve sockets.

Messrs H.M.V. (N.Z.) Ltd., resistors, condensers, hook-up wire, mounting hardware, etc. This firm has also offered to write to Messrs. E.M.I., England, to inquire whether they will provide one or more camera tubes. This gesture is very greatly appreciated, as this will certainly be the most costly item of equipment needed, as well as the most difficult to obtain.

Messrs. Ducon (N.Z.), Ltd., condensers of all types.

CHRISTCHURCH BRANCH NEWS

The Christchurch branch has been very active in the matter of general business, and has held special meetings to consider such matters as the proposed alteration in the location of Council, and other points recently brought to the attention of Council by remits from the Dunedin and Wellington branches. With regard to the location of Council, the Christchurch branch disagreed with the proposal by Wellington that the next location should be Christchurch, on the grounds that Dunedin has a potential Honorary National Secretary/Treasurer, and would therefore be a better place to which to move Council in the first instance.

An excellent idea that has been put into practice by the Christchurch branch is that of a lecturette competition. Details of the rules and methods of marking have not yet been made available, but there is no doubt that the idea is an excellent one, and should be seriously considered by other branches. The first two lecturettes were given at the branch meeting on 23rd February, Mr. A. L. Gardiner spoke on "New Developments in Ionospheric Recorders," and Mr. A. V. Butcher's subject was "An Aspect of Television Receiver Construction." It is hoped to secure detailed reports of these, and other lecturettes in the series, for publication in these Proceedings.

The branch also reports that one of its members, Mr. L. D. Hepburn, has presented it with an Edison-Dick duplicating machine, which will greatly assist the working of the branch.

WELLINGTON BRANCH NEWS

At the February meeting of the Wellington branch, suggestions were discussed for the reorganization of the central administration of the Institute. The proposals were that the present branch organization should remain, but Council would be established for a period of two years in each of the four centres in rotation. An Honorary Secretary/Treasurer would be elected in the city where Council is located, and would receive an honorarium of, say, £50 per annum. To assist him, essential items of office equipment would be purchased by the Institute.

At the same meeting, a demonstration was given by Mr. W. Neighbours, of Wellington Electronics Ltd., of a metal detector designed for detecting minute particles of metal in non-metallic objects passing along a conveyor belt. The equipment was more particularly designed for the continuous examination for metallic contamination of biscuits, chocolate, etc. Basically, the method used was to place a search coil round the belt, so that all the objects to be examined pass through the coil. The coil is excited by an oscillator, at a frequency of approximately 10 kc/sec., and is also connected in a bridge circuit, in which a null is obtained in the absence of any distortion of the field of the search coil by a piece of metal. The process of detection consisted in operating a relay (which in turn operated a warning device and stopped the belt) by detecting the bridge unbalance. Although very simple in principle, the practical difficulties to be overcome in such a system are very considerable, owing to the fact that the quantity to be measured is the very small difference between two large quantities. The main difficulties are those of slow frequency drifts and extraneous indications, caused by movements of large masses of metal in the vicinity of the instrument. Drifts such as these can completely overload an amplifier stage after a certain amount of amplification has been provided, so a partial solution is found in detecting the amplified out-of-balance signal, and using the envelope (which is the required signal) to modulate a carrier. Further amplification can then be carried out without difficulty, because the slow drifts referred to above cannot pass through the A.C. coupling which follows the detector circuit. In this way, stable amplifications of about a million times can be used without trouble from slow drifts. The equipment is capable of detecting pieces of metal hardly larger than the head of a pin, and yet is unaffected when large metallic objects are moved round in the vicinity of the search coils.

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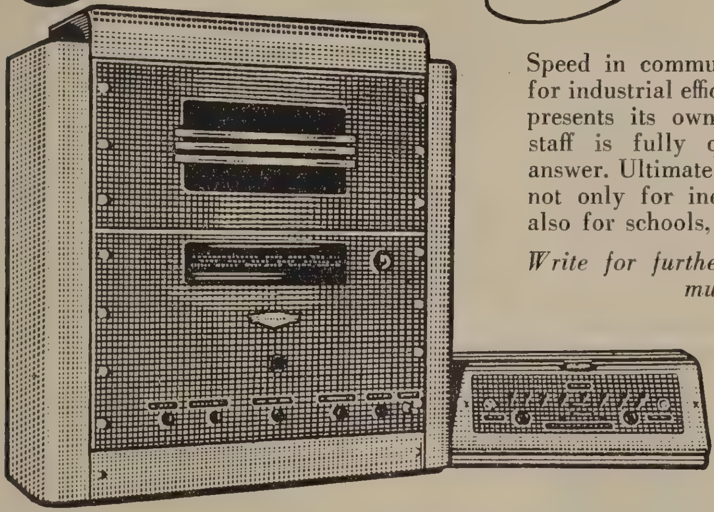

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TRADE WINDS

Radio Manufacturers' Executive Meeting

The Executive Committee of the New Zealand Radio and Television Manufacturers' Federation held one of its periodical meetings in Wellington on 11th and 12th March, when a considerable amount of important business was dealt with. In addition, deputations waited on the Board of Trade, submitting evidence on the industry's case for the easing of restrictions on the importation of condensers. Very full submissions were made, and the Federation is hopeful that some relief from the present curtailment of imports may be granted by the Board.

It was reported also that the Committee held important talks with Mr. Watts, the Minister of Industries and Commerce. At the time of going to press the subject matter of these talks was not available for publication, as the matters discussed were still under consideration by the Minister. It is hoped to be able to present a full report on this part of the Federation's work in the next issue of *Radio and Electronics.*

* * *

Visit to New Zealand by Sir Alexander Aikman

A warm welcome awaited a recent first-time visitor to New Zealand, Sir Alexander Aikman, Chairman of Directors of Electrical and Musical Industries, Ltd., the great British gramophone, radio and television firm which had its origins in the Gramophone Company, the originators of the famous "His Master's Voice" trademark. Sir Alexander came here in the course of a world tour of the many subsidiary companies of E.M.I., of which H.M.V. (N.Z.) Ltd. is the farthest away, and also the smallest.

He was impressed with the versatility of the New Zealand radio industry in general, and with that of his own company in particular. It was surprising, he said, to find such a small company (relatively speaking) engaged in the manufacture of such a wide range of products, especially in a country with a total population of only two million. Himself used to really large scale production, he found it remarkable that such small production figures could be economically justified.

Sir Alexander was interested to note that the greatly increased public demand for gramophone records was being met partly by H.M.V. (N.Z.) Ltd.'s own record factory, and he was particularly pleased to find that this company had already commenced to step up its production of records, thus heping to satisfy the demand without the expenditure of sterling funds. This was especially important, he said, in view of the current interest in the new long-playing records, which at present could not be pressed in New Zealand.

Sir Alexander is naturally much interested in television, which is a major activity of his company; he is also a member of the board of directors of a new company, the Associated Broadcasting Development Co., Ltd., which has as one of its main objectives the production of filmed television programmes, which will be so important to small countries like New Zealand when a television service is instituted.

While in New Zealand, Sir Alexander found time to sample the joys of Taupo and the Waikato, for he is a keen fly fisherman, and although very little luck came his way, he expressed the appreciation of a true fisherman, of the Huka Lodge and its environs.

CELESTION ARE BACK

The Celestion Speaker Company, a division of Pye (New Zealand) Ltd., is now able to offer a wide range of the famous Celestion speakers to radio manufacturers and radio traders throughout New Zealand.

For over 25 years, all the resources of the Celestion organization overseas have been concentrated on one problem—the design and construction of the finest speaker it is possible to produce. The result is a range of speakers famous throughout the world for all-round excellence and dependability. Full service and spares facilities will be available throughout all main centres in New Zealand.

Change of Address

With progress as their keynote, Dave Heinman of Electro-Technical Industrial Ltd., and his staff, are busy settling into their spacious new premises on the 5th floor of the Dixon Buildings, Wellington. As yet, it is an arduous and adventurous climb to their lofty home, while the building is undergoing extensive modernization, but soon the newest electric lift will bring you right into the showroom of this progressive and rapidly expanding firm.

* * *

Another recent change of address is that of the Auckland Branch of Messrs. Bradley's Electrical Co., Ltd. This branch is now to be found at 62A Cook Street, where all inquiries will be welcomed.

ELECTRO-TECHNICAL INDUSTRIES LTD.

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N.Z. Radio Traders' Federation

EXECUTIVE MEETING, 18th FEBRUARY, 1953

Amongst the matters discussed at the Executive meeting of the New Zealand Radio Traders' Federation, held in Wellington on 18th February, 1953, were the following:—

Fitting of 3-pin Plugs

It was reported that some manufacturers are now fitting 3-pin plugs.

Television

After considerable discussion concerning Ministerial and other statements relating to television, the meeting decided that the time was inopportune to proceed with the printing of a brochure explaining the television problem.

Trade-in Hand-book

Thanks were accorded to Mr. Souper for his work in the preparation of the Trade-in Hand-book, which will be available shortly.

It was resolved that the basis of distribution be: Affiliated associations to receive the number of copies requested, at no charge, provided the number does not exceed two copies per member, based on the current declaration of membership.

Further copies, if required, be supplied to Associations in bulk, at 6d. per copy, to cover distribution costs. The Executive recommends to Associations that they charge these additional copies at the rate of 1s. per copy to members and 2s. 6d. to non-members.

Badges

The matter of the deletion of the year at present printed on the transfer badge when reprinting is undertaken is to be brought before the next Annual Conference.

Finance

In view of certain structural changes within the Federation, the matter of balancing the budget is now causing considerable concern. Following Mr. Souper's report on the unsuccessful approach made to the New Zealand Employers' Federation concerning a reduction in the secretarial fee, it was resolved that a full report on the financial position of the Federation should be submitted to the Conference.

Annual Conference

As a result of the Canterbury Association's favourable reception of the suggestion regarding the venue of the next Conference, the Secretary was instructed to write ot the Canterbury Association formally requesting whether arrangements could be made for the holding of the Conference in Christchurch on 19th and 20th May, 1953. Should the reply be favourable, other associations will be requested to nominate their representatives.

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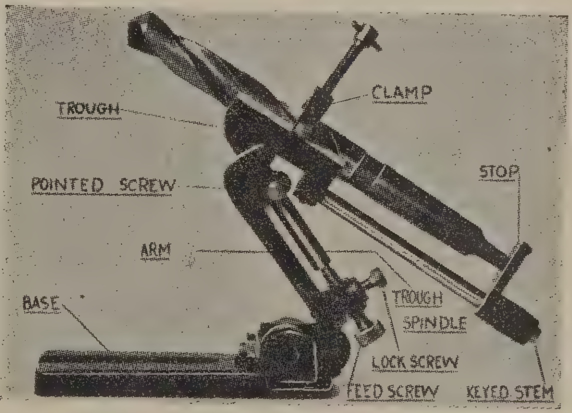

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Broadcasting Hours

During the general discussion concerning the Government's decision not to restore normal broadcasting hours meantime, the chairman drew attention to his letter to the Minister and to his subsequent press statement.

Interference Committee

A report was made on the considerable progress made towards the reduction of interference, and details were supplied of specific action already taken and future plans, which are now in an advanced stage.

* * *

TELEVISION IN THE U.S.S.R.

With the promoters hoping to enlist television in the Stalin programme for building Communism in the U.S.S.R., and assured of Government backing by the resolution passed at the recent Congress of the Communist Party of the Soviet Union, "to carry through further development of the cinema and television," Soviet engineers are pushing forward the development of television in the Soviet Union, with the aim of creating a nation-wide network.

According to Professor S. Kataev, a leading authority, the solution to this immensely difficult problem lies in the provision of low-priced, mass-produced television sets for family use, big screens for group viewings, and the co-aerial cable for inter-urban distance transmission.

Since the war, the 343-line picture has been superseded by the 625-line picture, now standard in Soviet television, described, in Moscow, as the best in the world. With the rise in quality, there has been a commendable drop in prices, and, according to report, present television sets costing about £116 and £223 5s. (an eighth of the pre-war charge) are bought as soon as they appear on the market. It is even rumoured that this year new, improved, sets are due at still lower prices.

Experiments are being made with enlarged type screens for group viewing, and according to a Moscow radio statement, the Popov Museum of Communication Media in Leningrad, is exhibiting a type of set with a screen about 15½ in. x 23½ in., which could be watched by some 40 viewers, and which it is proposed to install in workers' clubs and auditoriums.

PUBLICATIONS RECEIVED

Cory Wright and Salmon, Ltd. Stock Record, 1953. Machinery Lloyd, 2/11/1952.

Wireless and Electrical Trader, November, December, 1952, and January, 1953.

Radiotronics, Vol. 18, Nos. 1 and 2, January and February, 1953. (Amalgamated Wireless Australasia, Ltd.)

N.Z. Radio Traders' Federation, Bulletin No. 5, January/February, 1953.

Clayton Steam Generator, Kerrick Distributors Ltd., Newmarket, Auckland.

Westinghouse Engineer, January, 1953. H. W. Clarke (N.Z.), Ltd.

Get Right Down To The Job With An ORYX!

The new low-voltage soldering iron—weighs less than one ounce—9-watt consumption on A.C. or D.C.—available for 6, 12, or 24v. operation—replaceable push-on bits.

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> "Wireless World," January, 1952.

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Early Training in Television—Proposed Course of Lectures

In view of the fact that, as yet, the Government has not made any policy pronouncement concerning television in this country, the display of public interest is remarkable. Several manufacturers have commenced exploratory TV work in the seclusion of their laboratories, and a large number of engineers and technicians are taking steps already to lay the foundation of a sound knowledge of television practice, against the day when TV is introduced to this country as a public service.

Therefore, it caused us no surprise to receive the suggestion that the Editor of this journal should prepare and deliver a course of lectures, amplified and illustrated by demonstrations of equipment, aimed at giving those who are already radio engineers or technicians, an overall picture of modern TV technique, and an appreciation of the problems confronting them in dealing with TV.

SCOPE OF THE COURSE

The suggestion is that the course should comprise approximately ten lecture-demonstrations, each of about two hours duration. In this time it should be possible to make the series quite comprehensive. The emphasis would be on principles, treated in not too elementary a fashion, and on those techniques, practices, and basic theories which find little application in ordinary radio work, but which are of great importance in television. Clearly, in order to cover the ground adequately in the time available, it would be necessary to assume a reasonable standard of radio knowledge on the part of those taking the course, while, on the other hand, it is equally desirable to avoid presenting the material on too highly theoretical a plane. However, providing the right level is struck, it should be possible to design a course of immense value and interest to those wishing to acquire a solid base on which to build their TV knowledge by individual study and practical experimental work.

PRACTICAL DETAILS

In the first instance, the course would take place in Wellington, but should there be sufficient interest displayed, arrangements could be made for the same course of lectures to be given in other centres. It has been suggested, further, that, in order to make it easier for people to attend, the course should be concentrated into a period of three weeks, with four lectures presented in each of the first two weeks, and the remaining two in the third week. No doubt, many people would find the short concentrated period more satisfactory than the spreading of the course over, say, ten weeks, with only one lecture per week. To enable those interested to make the necessary arrangements to attend, adequate notice of the proposed dates would be given. Owing to the large amount of preparation involved in the way of diagrams and demonstration equipment, etc., it is not envisaged that the Wellington course could take place before August of this year. However, should the show of interest warrant proceeding with the idea, it is suggested that the course might be held during August or September. By such time, it is hoped that the Government will have made its policy pronouncement, and we shall all know just how soon TV will really be upon us.

FEES

Much as we might like to provide such a course as a free service to those in the industry, this is clearly an impossibility. Present estimations of the fee range in the region of from four to five guineas, a sum not really out of the way considering the scope of the course. However, should sufficient interest be shown, it might be possible to effect a subtantial reduction on this figure.

In this connection, we should appreciate some indication from readers concerning their interest in attending such a course. Those interested in taking part, therefore, are urged to complete the accompanying form and post it to our offices, with the superscription "TV Course" on the envelope. It is emphasized that completion of this form will not commit you to any expense, but it will enable us to assess whether the degree of interest justifies our proceeding with plans. Morever, it will also help us determine more accurately the amount of the minimum fee required.

Radio and Electronics,
Wellington.

I am interested in and would be prepared to attend the proposed TV course to be held in Wellington.

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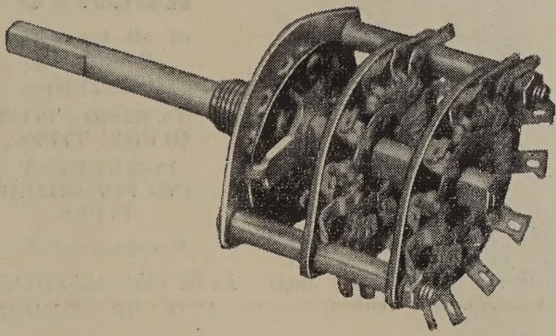

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Hitting the V.H.F. Bands

(Continued from Page 14.)

an oscillator well down the frequency scale, for reasons of stability, but such is the stability of the Clapp circuit that if we decide to use it, it should be possible to start off at quite a high frequency, and eliminate quite a deal of frequency multiplication. Why not make a Clapp oscillator to cover the basic range of 46.6–54 mc/sec.? It has been authoritatively stated that the Clapp circuit, together with its advantages, can be used at frequencies as high as 100 mc/sec., and we know of one amateur who has already had it working on the 6-metre band, with more stable results than an ordinary crystal followed by its string of multipliers.

One of the difficulties of so doing will certainly be that at the high frequency, output power will be low, and it will probably be imperative to follow the oscillator with a Class A buffer, so that the first tripler may be adequately driven. One thing is certain, a V.H.F. exciter built round such a V.F.O. would be compact, and would get us to the frequency with a minimum of expenditure in equipment and input power.

Abstract Service

(Continued from Page 27.)

has selectivity and stability not surpassed by factory-built receivers. Converters, and the audio-end, can be designed to taste.

—*QST* (U.S.A.), January, 1953, p. 19.

Some ABC's of V.H.F. receiver design: what makes a sensitive receiver?—the role of selectivity—with notes on the compromise between selectivity and signal-to-noise ratio.

—*Ibid*, p. 112.

TRANSMITTERS

Construction details are given of an electronic keyer which produces self-completing dots and dashes, with or without a delay. The arrangement permits the operator to send better and develops spacing between words and letters.

—*Radio and Television News* (U.S.A.), January, 1953, p. 52.

Based on a series of experiments, a comparison is made of the transmission performance of 150, 450, and 3700 mc/sec. in the mobile radio-telephone type of service. This comparison indicates that 450 mc/sec. is superior transmission to the 150 mc/sec. band in urban and suburban areas.

—*Bell System Technical Journal* (U.S.A.), November, 1952, p. 1068.

TELEVISION

The article is the first comprehensive treatment of a type of harmonic generation that represents the last barrier to completely TVI—proof operation in fringe areas—harmonic radiation from external non-linear systems. There are unfortunately innumerable such sources from a boy's crystal set to the kitchen sink, and altogether they present a problem which has all the elements of a nightmare.

—*QST* (U.S.A.), January, 1953, p. 11.

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- **Radio Electronics** 3/-
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- **C.Q.** 3/9
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A CORRECTION

We must apologize for the omission of the title from a book review which appeared in our November, 1952, issue. The book concerned was *Radio Interference Suppression*, by G. L. Stephens, A.M.I.E.S., published by Iliffe and Sons, London, and the first two lines of the review, containing both the title and the author's name were unfortunately omitted from Page 13.

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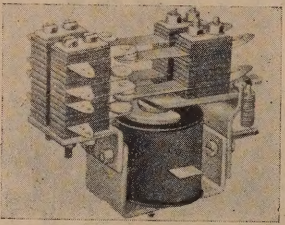

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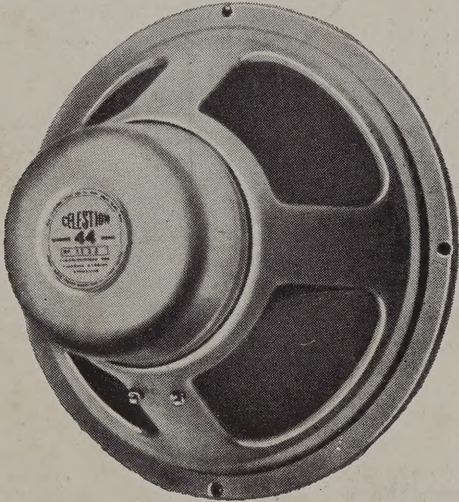

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2400 ft.	10½ in.	120 min.	60 min.	30 min.
1200 ft.	7 in.	60 min.	30 min.	15 min.
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